

Government of West Bengal
Irrigation & Waterways Department
Jalasampad Bhavan, Salt Lake, Kolkata – 700 091

No.61-ACS/I&W/2017

Dated, 7th November, 2017

To
The Chief Secretary
Government of West Bengal

Subject: Identification of infrastructure gaps, formulation of projects and gap funding etc.

Reference: Meeting of the Chief Secretary held on the subject on 22.09.2017.

Sir,

Reference may kindly be made to the above said meeting wherein various Departments dealing with infrastructure development were asked to complete an exercise of finding infrastructure gaps in their areas of work so as to take up viable projects in the short and medium term horizon of 3 to 7 years to substantially fill up this gap to enable the State Government to find various sources of additional funding to meet this gap.

2. It was also decided in the above referred to meeting that while projecting requirement of funding for such projects, already available funding under State budget or from other sources should be taken into account and such costs projections should be made at the current costs. Reference may also be made to the Memo No.160/CS/2017 dated 25.09.2017 of the Cabinet Secretariat in this regard.

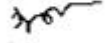
3. The Irrigation & Waterways Department has accordingly conducted a detailed exercise to identify infrastructure requirements in the irrigation and flood management sectors with a view to identify critical infrastructure gaps which are not possible to be filled up in the short and medium term with the current and projected budgetary and other funding sources available. Accordingly, 12 distinct projects have been identified for being taken up with additional infrastructure funding likely to be made available to fulfill the gaps in infrastructure requirements in these two critically important sectors.

4. While formulating these project proposals, the existing and already created irrigation and flood control infrastructure has been taken as the baseline and an effort has been made to fully utilize the infrastructure potential already created in the first instance by taking up schemes relating to rejuvenation and rehabilitation and to further enhance irrigation and flood control infrastructure keeping in view various constraints like acquisition of land and existing ground conditions etc. The projected requirements are in accordance with the vision document of the I & W Dept., formulated in July 2016. The cost estimates of the projects have been assessed at the current price level following present norms and acceptable standards.

5. While the total assessed value of undertaking these projects is approx. ₹ 12,044 crores, after taking into account budgetary funding and other resources likely to be available over the period of implementation, the funding gap has been assessed at approx. ₹ 9,013 crores. While assessing the funding requirement for the projects which are to be implemented within 4 year period, estimated costs have been kept constant while for projects with implementation period beyond 4 years, the requirement has been assessed after indexing current level of estimated costs by a factor of 1.25 for the remaining period of implementation to account for likely inflation.

6. I am accordingly submitting herewith a detailed note analyzing the critical infrastructure gaps in the irrigation and flood control management sectors followed by detailed assessment of requirements to fill up infrastructure gaps with detailed justification, rational and objectives of the proposed projects. After receiving in-principal approvals Detailed Project Reports (DPRs) will be drawn up.

Yours faithfully,



(Naveen Prakash)
Additional Chief Secretary

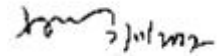
Encl. As above

No.61/1(1)-ACS/I&W/2017

Dated, 7th November 2017

Copy along with a copy of the note forwarded for kind information to:

Shri H.K. Dwivedi, IAS
Principal Secretary
Finance Department



(Naveen Prakash)
Additional Chief Secretary

Encl. As above



**NOTE ON ANALYSIS OF CRITICAL INFRASTRUCTURE
GAP & ASSESSMENT OF ADDITIONAL FUND THEREFOR**

NOVEMBER 2017

GOVERNMENT OF WEST BENGAL
IRRIGATION & WATERWAYS DEPARTMENT
JALASAMPAD BHABAN, BIDHANNAGAR
KOLKATA 700091

Identification and analysis of infrastructure gap under the domain of the Irrigation & Waterways Department and assessment of requirement of additional funds to bridge the identified critical infrastructure gap

Executive Summary

- Pursuant to the decision taken in the meeting of the Chief Secretary on 22nd September 2017, at Nabanna, on planning for infrastructure projects in the State, Irrigation & Waterways Department (I&WD) has taken up an exercise to identify the critical infrastructure gap within the domain of activities of the Irrigation & Waterways Department in irrigation development, flood management and rural connectivity sectors.
- After taking into consideration resources available for identified ongoing or planned Projects in the near term or medium term, infrastructure gap is identified for such activities that are in consonance with the Department's vision mission and objectives over medium and long term.
- These critical gaps required to be filled up for stabilizing the existing Irrigation & Waterways Department infrastructure and related activities essentially required for functioning with the desired level of efficiency have been quantified in 12 distinct projects. Various measurable outcomes of these projects include restoration of lost irrigation potential of completed Major and Medium/Minor Irrigation schemes, creation of new irrigation potential by harnessing surface water in rivers and channels, improvement of flood embankments including Ex-zamindari embankments, construction of river bank protection & anti sea-erosion works, improvement of drainage channels with construction of additional regulating structures and pump houses, and replacement of wooden and old dilapidated bridges on rural roads by new RCC bridges with pre-fabricated design etc.
- While assessing the critical gaps the outcomes of ongoing and recently approved projects already scheduled for execution whether under central or external funding, have been excluded. Accordingly, modernization of DVC areas and rejuvenation of flood management infrastructure in Lower Damodar areas, already included under externally funded "West Bengal Major Irrigation and Flood Management Project", have not been considered during the present analysis.
- Estimated costs of the said 12 projects have been assessed at current price level, following present norms and acceptable standards. The project components are doable on the ground and do not generally require any additional land, other than in exceptional cases.
- Total estimated cumulative cost of such projects is ₹ 12044.93 crore. Implementation period of these projects varies from 3 years to 6 years depending on the prevailing norms of execution of similar ongoing projects. While assessing the total requirement of funds during the project implementation period, requirement of fund for the projects having upto 4 year implementation period, has been considered upto the ceiling limit of current level estimated costs of these projects. However, requirement of funds for projects having implementation period beyond 4 years, has been assessed after indexing the current level estimated costs, by a factor of 1.25,

to cater for the possible inflation. Adjusting for inflation the total requirement for these 12 projects has been assessed at ₹ 13623.21 crore.

- Normal projectwise budgetary availability during the project implementation period, has been assessed in consideration of apportioned budgetary provisions of 2017-18 in irrigation, flood management, drainage and rural connectivity sectors under Core State Plan and RIDF as the base, together with 15% annual growth on year to basis, to arrive at the total available funds for the entire implementation period. The available budgetary source is ₹ 4609.54 crore.
- The final funding gap for these 12 projects have been assessed as **₹ 9013.67 crore**, after deducting the cumulative budgetary availability from the assessed requirement of funds.
- A short summary on salient features related to the projects has been shown at Table-I below.

Table – I

Sl. No.	Project ID	Brief Name	Estimated Cost at current prices (₹ Crore)	Implementation period (Years)	Requirement of fund after taking into account likely inflation for project implementation period of more than 4 years (₹ Crore)	Likely availability of normal budgetary resources (₹ Crore)	Assessed funding gap (₹ Crore)
1	2	3	4	5	6	7	8 = 6 – 7
1	IW/I/1	Rejuvenation and improvement of five Major Irrigation Projects	1728.44	5	2160.55	1053.00	1107.55
2	IW/I/2	Rejuvenation and improvement of 57 Medium & Minor Surface Irrigation Schemes	300.00	3	300.00	135.72	164.28
3	IW/I/3	Construction of 11 number rubber dams across different channels and rivers	133.48	3	133.48	0.00	133.48
4	IW/FM/1	Rejuvenation, improvement and extension of flood management infrastructure in the districts of Darjeeling, Jalpaiguri, Alipurduar & Coochbehar	1412.75	5	1589.00	990.00	598.10
5	IW/FM/2	Reconstruction and improvement of flood management infrastructure in Uttar & Dakshin Dinajpur & Malda	771.22	3	771.22	255.43	515.79

Sl. No.	Project ID	Brief Name	Estimated Cost at current prices (₹ Crore)	Implementation period (Years)	Requirement of fund after taking into account likely inflation for project implementation period of more than 4 years (₹ Crore)	Likely availability of normal budgetary resources (₹ Crore)	Assessed funding gap (₹ Crore)
1	2	3	4	5	6	7	8 = 6 – 7
6	IW/FM/3	Anti-erosion and river training work at critical stretches on Ganga-Padma and Bhagirathi in Malda, Murshidabad and Nadia districts.	716.50	5	895.63	0.00	895.63
7	IW/FM/4	Ghatal Master Plan (Phase I Works) in Paschim and Purba Medinipur Districts	1238.95	4	1238.95	0.00	1238.95
8	IW/FM/5	Raising, strengthening & improvement of I&WD embankments in 11 South Bengal Districts	670.10	3	670.10	383.15	286.95
9	IW/FM/6	Improvement of Ex-zamindary embankments in 11 South Bengal Districts	732.30	3	732.30	0.00	732.30
10	IW/FM/7	River bank protection work in 10 South Bengal districts and coastal protection & beautification work in Purba Medinipur District	1178.00	3	1178.00	510.86	667.14
11	IW/FM/8	Rejuvenation and improvement of drainage infrastructure in 10 South Bengal Districts	1321.77	5	1652.21	945.00	707.21
12	IW/BR/1	Replacement of wooden and old bridges over canals/channels by RCC bridges in 10 South Bengal Districts	1841.42	5	2301.77	335.48	1966.29
Total			12044.93	–	13623.21	4609.54	9013.67

- Details of rationale, objectives, estimated costs and gap funding for each of the projects and likely benefits to be derived after implementation of the projects have been stated in Para 7 and Para 8 of the Note with sub paragraphs thereunder. Summary of the projects considered for gap analysis may be seen at the Annex.

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**Note on Identification and analysis of infrastructure gap
under the domain of the Irrigation & Waterways
Department and assessment of requirement of
additional funds to bridge the identified
critical infrastructure gap**

Introduction

1.0 Chief Secretary, Government of West Bengal chaired a meeting on 22nd September 2017 at Nabanna on planning of infrastructure projects in the State. It was decided that various concerned Departments under the State Government would identify and analyze the critical gaps in infrastructure and assess the requirement of funds, over and above the normal budgetary support, to explore various options for mobilizing such additional resources and take up important infrastructure projects in the next 3 to 7 years. Accordingly, an exercise has been taken up by the Irrigation & Waterways Department to study and analyze critical infrastructure gap and to prepare a Concept Note on the Action Plan in this regard, based on prevailing ground realities and Perspective Plan considered in the Vision Document of this Department. The approach in analyzing the critical infrastructure gap and assessing the additional gap funding required has been elaborated in Paragraph-4.

Background

2.0 Irrigation & Waterways Department is responsible for development and regulation of Inland Water Resources through major, medium and occasionally minor surface irrigation projects and also for preventing and controlling floods and waterlogging. Irrigation potential created by these schemes till the year 2016-17 is 16.31 lakh hectare against the ultimate achievable potential of 20.11 lakh hectare. Completed major irrigation projects having command area more than 10,000 hectare are Barrage & Irrigation Systems of Damodar Valley Project (DVP), Mayurakshi Reservoir Project (MRP), Hinglow Irrigation Project (HIP), Kangsabati Reservoir Project (KRP) and Midnapore Canals Project (MCP). Ongoing major project is Teesta Barrage Project. Another ongoing project, i.e. Subarnarekha Barrage Project has not shown any significant progress mainly due to problems associated with land acquisition and other constraints. There are 169 completed medium and minor irrigation projects. Irrigation & Waterways Department also maintains 10,284 km length of flood embankments and 8,244 km length of rivers and drainage channels.

Vision Statement

3.0 To harness river and surface water resources in the State in a sustainable manner to optimize the Irrigation Potential and to regulate and moderate effects of floods and drainage congestion through scientific Flood Management interventions.

Objectives

4.0 Following objectives, as enshrined in the Vision Document are to be met up through sustainable improvement of infrastructure in surface irrigation, flood management and rural connectivity sectors.

(a) **Reducing the gap between Irrigation Potential Created (IPC) and Irrigation Potential Utilized (IPU) through Revitalization of existing irrigation infrastructure**

Loss of irrigation water due to seepage and dilapidated structures and silted up distribution network has reduced the efficiency of the entire system. Therefore, efforts are required to revamp and modernize the entire distribution system of major and medium / minor projects in a phased manner, for revitalization and modernization within a period of 3 to 6 years to enhance and optimize their irrigation potential. Necessity of taking up such works for restoration of lost irrigation potential has become more relevant in view of difficulties in increasing irrigation coverage through implementation of new schemes due to land and other constraints.

(b) **Storing and Harnessing Surface Water**

The annual rainfall in West Bengal varies from 1200 mm to 3500 mm. Low rainfall in western districts is also only slightly above average rainfall of comparable districts in India. However, surface and groundwater availability comes under stress during prolonged non-monsoon months, particularly during peak and end of summer, as storage facility of surface run-off is grossly inadequate and more than 80% flows down to sea. The State Government has already taken steps to construct a number of structural interventions across channels, streams and minor rivers in the relatively water stressed western districts under 'Jalathirtha' programme towards conservation and harnessing of surface water. The projects are mainly implemented by Water Resources Investigation & Development Department (WRI&DD), though Irrigation & Waterways Department (I&WD) was also an implementing agency in Purulia District. It is proposed to explore the feasibility of construction of similar interventions in the form of rubber dam or other structures across channels, canals and rivers in various Central & South Bengal districts (other than the western districts of Purulia, Paschim Bardhaman, Bankura and Birbhum), to promote multifarious activities like irrigation, fishery, duckery and also for groundwater recharging and soil conservation.

(c) **Improvement of Flood Management Infrastructure**

(i) **Embankments**

The I&WD maintains around 10,284 km length of flood embankment throughout the State including seawall and coastal embankments in Purba Medinipur & South 24-Parganas districts. In addition to these embankments, onus of maintenance of entire length of embankments, built during pre-independence period by local zamindars and so far looked after by local Panchayat authorities, has also been entrusted to the I&WD. The embankments, both under I&WD and Ex-zamindary are mostly earthen, while around 1300 km is permanent armoured with cement / brick / boulder pitching. It is proposed to upgrade the embankments by raising,

strengthening and armouring wherever required and feasible, so as to provide reasonable degree of protection to the flood prone areas, which comprises of around 43% of the total geographical area of the State. Emphasis would also be laid on using innovative and state-of-the-art technologies during construction and improvement work of embankments by use of geo-textiles and geo-synthetic materials and other modern techniques.

(ii) Drainage Channels

Siltation in drainage channels, changing land use patterns leading to generation of increased run-off, various human interventions in the channels and rivers are major problems in flood management in critically flood prone South Bengal districts. Thorough re-excavation works are required to be carried out almost at five to six year intervals in critical drainage channels, particularly in urbanized and semi urban areas in Kolkata and adjoining districts. Accordingly, restoration of carrying capacities of important drainage channels and rivers by capital desiltation and laying more emphasis on pumped discharge, either by commissioning new pump houses or augmenting capacities of existing pump houses are priority agenda to the I&WD, from the point of view of easement of drainage congestion.

(iii) Erosion Control

Bank erosion in river Ganga-Padma, Bhagirathi-Hooghly and various other rivers in North and South Bengal and sea beach erosion in the coastal areas of Purba Medinipur have assumed critical proportion. Thousands of hectare of lands, and public utilities & private properties worth hundreds of crore have been engulfed by rivers and sea due to such erosion. The dynamics of erosion undergo frequent changes and anti-erosion works are required to be taken up at numerous locations on urgent basis throughout the State to minimize such losses.

(d) Improving Rural Connectivity

The target of building up well connectivity in remote rural areas for quicker access to District / Subdivision / Block Headquarters, schools, colleges, market places, etc. is being achieved through Bangla Grameen Sadak Yojana or other similar programmes. Such roads cross over numerous drainage channels and irrigation canals, and the connecting bridges, originally built by the I&WD in many areas are often wooden or narrow and old RCC bridges. The endeavour of the I&WD is to replace the wooden or narrow and dilapidated old RCC bridges by construction of new RCC bridges, in next 5 years through a comprehensive Action Plan. The total number of such bridges mostly in rural areas and also a few in Kolkata Metropolitan Area, excluding those under SH, NH and Major District Road, is 1014 at present. Implementation of such a plan would provide substantial and tangible social benefit to the rural population by way of quicker

and easier access to important locations and boost up rural economy due to reduction in distance for transportation of agricultural produces to the market, besides easier access to health, educational and recreational facilities.

Broad sectors of infrastructure gap in the perspective of ongoing trend of development activities

5.0 Development activities undertaken by the I&WD have increased manifold during last few years compared to the previous years, as evident from the key indicators of physical achievements, shown in Table – 1.0 below:

Table – 1.0

Sl. No.	Key indicators	Unit	Achievements during 2011-12 to 2016-17	Annual average during the past six years	Annual average of preceding four years (2007-08 to 2010-11)
1.	Additional area brought under irrigation by restoration of lost potential / creation of new potential	Hectare	1,43,850	23,975	9,325
2.	Length of embankments renovated / strengthened / constructed	Km	2,614	436	160
3.	Length of drainage channels / rivers re-excavated	Km	1,240	207	100
4.	Permanent bridges constructed in replacement of old & dilapidated bridges / new bridges constructed for better connectivity	No.	249	41	5

However, infrastructure gap, resulting in lowering of efficiency of operation and functioning of the present irrigation systems still remains in some cases, which cannot possibly be filled up within next couple of years, considering the present trend of availability and annual growth of normal budgetary availability.

- Restoration and stabilization of lost irrigation potential in case of completed Major, Medium and Minor Irrigation Projects and exploring avenues of harnessing surface water in a more sustainable manner.
- Improvement of flood management infrastructure by strengthening weak embankments and bank protection works in various districts and also by constructing new interventions.
- Implementation of long pending drainage schemes awaiting central funding for a long time, e.g. Ghatal Master Plan.

- Re-excavation of drainage channels and rivers in various South Bengal Districts and installing new pump houses and other regulatory structures for quicker drainage of storm water in Kolkata and adjoining districts.
- Replacement of wooden and old bridges of inadequate carriageway width and waterways, by properly designed new RCC bridges with pre-fabricated super standards to improve rural connectivity.

All these interventions, planned to be taken up and completed within next 3 to 5 years, require additional funding, over and above the normal budgetary support be made available during the said period

Analysis of infrastructure gap

6.0 After an assessment of infrastructure gap presently existing in various sectors under the domain of activities of the I&WD, cluster of projects (total 12 numbers) have been identified covering the relevant districts, to meet the gap within a maximum period of next 7 years as stated in Para 5.0 above. While identifying such projects, field constraints, particularly relating to large scale acquisition or procurement of land have duly been considered and the doable activities, essentially required for stabilizing the existing system and requiring practically negligible additional land have been included in the project proposals. It is pertinent to mention that use of new, state-of-the-art and low cost technologies have been considered wherever feasible so as to maximize efficiency and at minimum cost. Estimated costs of the projects at current price level have been arrived on pro-rata basis, based on past records, wherever detailed estimates are not readily available. Requirement of fund for the projects having upto 4 years implementation period would be on the basis of equal to the current costs. However, such requirement for projects spanning more than 4 years and upto 7 years has been considered to be 1.25 times the current costs. Availability of normal budgetary allocation under State Core Plan and RIDF, considering BE of 2017-18 as the base year (₹ 834 Crore) is assumed to increase at the rate of 15% annually and has been considered as the only funding source, as programme-specific central funding has practically ceased to flow. Finally, the funding gap has been calculated project-wise, after deducting the likely availability of budgetary funds from the total requirement of funds of such project. While ascertaining project-wise availability of normal budgetary allocations, suitable apportionment of the total provision on percentage basis has been made against the individual projects. Projectwise narratives on the exercise of gap analysis have been detailed in the subsequent paragraphs (Para 7.0 to Para 9.0). Summary picture showing name of the projects, project rationale and objectives, physical targets, total requirement of fund and consequent tap funding, along with other relevant information has been presented as Annex. The total assessed funding gap for 12 projects stands to the tune of ₹ 8,944.63 crore (Total requirement of fund amounting to ₹ 12,042.98 crore less likely availability of normal budgetary funds to the tune of ₹ 4,676.63 crore).

Projects identified during infrastructure gap analysis, requiring additional funds, beyond the normal budgetary supports

7.0 Irrigation Sector

7.1 Rejuvenation and improvement of five Major Irrigation Projects (Project ID: IW//1)

7.1.1 Rationale & Objectives

There are five Major Irrigation Projects, presently under operation in West Bengal, i.e. Barrage & Irrigation Systems of the Damodar Valley Project (DVP), Mayurakshi Reservoir Project (MRP), Hinglow Irrigation Project (HIP), Kangsabati Reservoir Project (KRP) and Midnapore Canals Project (MCP). These projects were completed decades back. Assessment of gap for the DVP and rehabilitation as well as modernization of that project has already been considered under the externally assisted “West Bengal Major Irrigation and Flood Management Project”. Another project, i.e. Teesta Barrage Project (TBP) although started decades back, could not be fully implemented due to various reasons, mainly related to land related issues and other constraints including non availability of adequate water during post monsoon (lean) season. The gap between Irrigation Potential Created (IPC) and Irrigation Potential Utilized (IPU) or between the Culturable Command Area (CCA) originally envisaged and average area under Kharif irrigation, as being done now, is widening with the passage of time due to various reasons, including somewhat dilapidated condition of the canal distribution network, particularly at the tail reaches and non-commissioning of supplementary storage facilities originally planned in the projects. The assessed gap for the remaining five projects stands to the tune of 2,11,908 ha on the basis of current assessment. However, keeping in view the prevailing field conditions, it has been considered that a part of the gap (approximately 55%) attributable to the degraded canal systems could be made up by various structural interventions, but the gap associated with creation of additional storage, cannot possibly be bridged due to involvement of large scale land acquisition. Since there have already been changes in the land use pattern over the preceding decades due to urbanization and industrialization, some gap will still remain even after overhauling the canal distribution system, as some of the lands within the command area are no more cultivable and used for other purposes. Summary picture of CCA/IPC, presently irrigated area/IPU, gap as per original project plan and achievable gap that can realistically be bridged has been shown below projectwise at Table – 2.0.

Table – 2.0

Project	CCA/IPC (ha)	Average Kharif area irrigated/IPU (ha)	Gap as per original project plan (ha)	Achievable extent of gap filling (ha)	Remarks
Mayurakshi Reservoir Project	2,34,000 (CCA)	1,97,000 (Area irrigated in Kharif)	37,000	15,300	Out of 40% of the remaining gap, schemes for fulfilling around 35% of the gap have recently been taken. Remaining 5% cannot be filled up.
Hinglow Irrigation Project	10,117 (CCA)	6,879	3,238	2,914	Remaining 10% gap cannot be filled up.
Kangsabati Reservoir Project	3,40,000 (CCA)	1,97,000 (Area irrigated in Kharif)	1,43,000	50,050	Remaining 65% of the gap related to creation of additional storage facilities by constructing upper Kangsabati Dam and/or converting 3 existing pick up barrages to reservoirs, with construction of a new supplementary storage dam on Joypande River, cannot be filled up.
Midnapore Canals Project	49,370 (IPC)	40,000 (Projected IPU)	9,370	8,433	10% gap will remain.
Teesta Barrage Project	73,300	54,000	19,300	19,300	Realistically achievable CCA from various considerations is 73,300 ha, as per draft Report of the Expert Task Force.
Total 5 Projects	7,06,787	4,94,879	2,11,908	95,997	–
Say	–	–	–	96,000 ha	–

In the context of above, it is considered to take up a main scheme, comprising sub-schemes for each of the five major irrigation projects stated above, so as to fill up the target gap of 95,997 ha, say **96,000** ha. Improving the efficiency of the canal distribution system will not only bring additional 96,000 ha under irrigation coverage, but also stabilize the irrigation potential in the entire command to a considerable extent without any requirement of any additional water, over and above the present availability. One of the main objectives would be to increase the efficiency of the distribution network, which would, inter-alia, help in reducing the relatively costlier investment on groundwater withdrawal for irrigation by the tail end farmers. Implementation of the proposed components, would not generally involve any further land acquisition.

7.1.2 Project Items

Various items of works of the project would include but not be limited to the following:

- Desiltation and lining of canals in critical and selective stretches to increase conveyance efficiency.
- Remodelling / modernization / new construction of regulating structures, to minimize operational losses.
- Remodelling outlet gats to minimize wastage of water.
- Modernization of irrigation monitoring mechanism
- Automated operation of gates of dams, barrages and regulating structures, on or offtaking from the main canals.
- Construction of auxiliary spillway for Kangsabati reservoir to effectively discharge additional flood water.

7.1.3 Estimated Cost and Assessment of Funding Gap

In absence of componentwise detailed estimate at this stage, present cost per hectare of CCA for improvement of parts of completed major projects has been fixed at ₹ 1.70 lakh, on an average based on recently executed schemes. Further, considering the additional cost of construction of auxiliary spillway for Kangsabati reservoir, and cost of automation of dam / barrage / regulator gates on main canals on all the systems, net cost per hectare has been arrived at as ₹ 2.15 lakh per ha ($\text{₹ } 1.70 \text{ lakh / ha} \times 1.125 \times 1.125$) for KRP and ₹ 1.91 lakh / ha ($\text{₹ } 1.70 \text{ lakh/ha} \times 1.125$) for other four projects and total cost of the project has been worked out as ₹ 1728.44 crore as shown below.

Sub-Project	Estimated Cost (₹ Crore)
Rejuvenation and improvement of MRP	292.23
Rejuvenation and improvement of HIP	55.66
Rejuvenation and improvement of KRP	850.85
Rejuvenation and improvement of MCP	161.07
Rejuvenation and improvement of TBP	368.63
Total	1728.44

Considering five year implementation period, total requirement of fund would to the tune of ₹ 2160.55 crore ($\text{₹ } 1728.44 \times 1.25$). As against this, normal budgetary allocations have been calculated as cumulative budgetary funds to be available during next five years, considering the BE of ₹ 156 crore for the base year of 2017-18 (60% of total budgetary provision under irrigation sector out of Core State Plan & RIDF) and with a growth of 15%

per year. The sum works out to ₹ 1053 crore (₹ 156 crore x 5 x 1.35, where 1.35 is the multiplier for 15% annual growth over a period of 5 years). Accordingly, **the funding gap is assessed as ₹ 1107.55 crore** (₹ 2160.55 cross less ₹ 1053 crore).

7.1.4 Project Benefits

Bringing an area to the tune of 96,000 ha would give rise to additional yield of Kharif paddy to the tune of 1,65,000 MT. In addition to this, there would be additional generation of Rabi crops and winter/summer vegetables. Considering the limited scope of taking up new major irrigation projects, this additional irrigation coverage in the command area of these projects, in the relatively water stressed western districts of Birbhum, Bankura, Paschim Medinipur, Jhargram and western parts of Murshidabad & Hooghly, will boost up local agronomy.

7.2 Rejuvenation and improvement of 57 Medium & Minor Surface Irrigation Schemes in Purulia, Jhargram, Bankura & Jalpaiguri Districts (Project ID: IW/II/2)

7.2.1 Rationale & Objectives

Irrigation & Waterways Department commissioned a good number of Medium and Minor Irrigation Projects in various districts four to five decades back, in Purulia, Midnapore (now Jhargram), Bankura and Jalpaiguri Districts. The schemes generally have a small storage dam across streams, minor rivers etc., headworks and canal distribution network generally having a length of 100 to 200 km, either in one or two / three adjoining Blocks. Many of the schemes have lost functional efficiencies to a considerable extent over the years due to various reasons stated in Para 5.1.1 above and also due to loss of storage capacities of the reservoirs due to siltation. 57 of such Medium / Minor Irrigation Schemes have been identified districtwise for filling up of the gap to restore / increase irrigation coverage, by way of various structural interventions as shown below in Table – 3.0.

Table – 3.0

Project	CCA/IPC (ha)	Average Kharif area irrigated/IPU (ha)	Gap as per original project plan (ha)	Achievable extent of gap filling (ha)	Remarks
Medium / Minor schemes in Purulia (32 Nos.)	35,000 (IPC)	28,000 (IPU)	7,000	6,000	15% of the gap will remain due to incomplete land acquisition and other reasons.
Medium / Minor schemes in Bankura (11 Nos.)	5,259 (CCA)	2,657 (Area irrigated)	2,612	2,351	10% of the gap will remain due to change in land use pattern.

Table – 3.0 (Contd.)

Project	CCA/IPC (ha)	Average Kharif area irrigated/IPU (ha)	Gap as per original project plan (ha)	Achievable extent of gap filling (ha)	Remarks
Medium / Minor schemes in Jhargram (13 Nos.)	7,585 (CCA)	5,627 (Area irrigated)	1,958	979	50% of the gap will remain due to substantial change of land use pattern because of urbanization, industrialization etc. and other reasons, which are irreversible in nature.
Jhumur Ghorahaga Minor Scheme at Jalpaiguri (1 No.)	729 (IPC)	295 (Area irrigated)	434	638 (Refer Remarks)	In case of the instant scheme, there is scope of extension by remodelling the head works and further extending the canal system, which would not require any additional land.
Total 57 Projects	48,573	36,579	12,004	9,968	–

The target gaps could be filled up in a relatively shorter period of time, of say 3 years. Although cost per hectare would be slightly higher than the major projects, because of lesser scope of apportionment of cost of headworks and other structures to a relatively small command area, the benefits could be quickly passed on to the targeted beneficiary farmer. Considering lesser scope of conflict in water utilization between head and tail reach farmers due to small size of command area and also lesser quantum of conveyance loss due to shorter length of canal network, these schemes have the prospect of running with very high efficiency after revamping.

7.2.2 Project Items

Various items of works would include:

- Desiltation and lining of canals in selective and critical reaches to increase conveyance efficiency.
- Remodelling / modernization of regulating structures and outlet gates to minimize operational losses and wastage of water.

7.2.3 Estimated Cost and Assessment of Funding Gap

Following the same methodology as explained in Para 7.1.3 above, cost per hectare is considered as ₹ 3 lakh. No indexing is considered as the project can be completed within

three years. Total estimated cost thus works out to ₹ 300 crore. Considering a budgetary allocation of ₹ 39 crore (15% of total outlay on irrigation of ₹ 260 crore) for the base year of 2017-18, for medium / minor irrigation projects with an annual growth of 15%, total availability of normal budgetary allocation during the project implementation period of three years is ₹ 135.72 crore (3 x ₹ 39 crore x 1.16, where 1.16 is the multiplier for 15% annual growth over a period of 3 years), **leaving a funding gap of ₹ 164.28 crore** (₹ 300 crore less ₹ 135.72 crore).

7.2.4 Project Benefits

Restoration of 10,375 ha of potential is likely to generate additional yield of Kharif paddy to the tune of 15,600 MT. Additional yield of Rabi crops and winter vegetables is also expected, subject to availability of water in the reservoirs after monsoon.

7.3 Construction of rubber dams across drainage channels and rivers in the districts of Paschim Medinipur, Purba Bardhaman, Hooghly & North 24-Parganas (Project ID: IW/1/2)

7.3.1 Rationale & Objectives

Construction of rubber dams across drainage channels and rivers for storing and harnessing of a part of monsoon discharge and replenishing such storage in the tidal stretches of channels and rivers by allowing judicious ingress of backwater or tidal water during high tide period of periodic interval is a relatively new concept. Such rubber dams are made up of multilayered reinforced rubber and look like a 'U' shaped strip of nominal sheet thickness. These are to be anchored with multi-compartmental RCC 'U' trough of suitable span length and height, having base slab and side walls constructed in-situ across the channel / river width. These rubber dams can either remain in deflated condition for allowing free discharge, without any practical obstruction or can be inflated by water / air by electrical / diesel operated centrifugal pumps to form an elliptical barrier across the channels, for intercepting the upstream flow. Individual span length of rubber dams varies from 10 m to 100 m and the maximum height after full inflation may be 5 m. Rubber dams in non tidal channels and rivers can be kept in fully deflated condition, i.e. flush with the channel bed during monsoon period and can be kept in fully inflated condition starting from the fag end of the monsoon and upto the entire dry season, till next monsoon for storing last monsoon flow as well as post monsoon base flow. In tidal channels, storage created in the abovesaid manner can further be replenished by periodical deflation, followed by inflation for accommodating a part of tidal water in the upstream reservoir. Surface water stored thus in the upstream of rubber dams can be effectively used for lift / surface irrigation in the adjoining fields, fishery, duckery, various domestic purposes and also for groundwater recharging. There is immense potential of harnessing water by construction of such rubber dams, as is already being done in Orissa, Andhra Pradesh and neighbouring

Bangladesh for more than a decade. However, it has been thought prudent to take up rubber dam constructions at a few places on pilot basis, to start with, since this will be the maiden effort of the I&W Department in respect of such construction. These rubber dams are easy to install, require lesser time and somewhat lesser cost involvement for commissioning of conventional sluices / regulators. Operation of these dams also would not be major issue and due to larger spans, resultant loss of head during flow would be much less compared to conventional sluices / regulators. It has been reported that average life span of these structures is 35 years, after which full / part replacement may be made, keeping the RCC trough holding the dams, more or less intact, with nominal structural modifications. Another major advantage of construction of rubber dams in tidal channels is to minimize siltation, in the upstream channel section, by arresting tidal flow during non-monsoon season, thereby avoiding cost prohibitive channel desiltation works every four to five year interval. Silt accumulated in the immediate downstream reaches of the dams can be removed by flushing discharge during the initial freshet flow. It has been planned to construct 9 nos. small size rubber dams in 6 drainage channels / minor rives (mostly non-tidal) in Purba Bardhaman and Hooghly Districts and 2 major rubber dams, one across river Ichhamati at Block Swarupnagar in North 24-Parganas and another on river Kaliaghai at Block Sabang, District Paschim Medinipur. Salient features of the proposed dams are shown below in Table – 4.0.

Table – 4.0

District	Location Blocks	River / Channel	No. of rubber dams	Each length (m)	Total length (m)	Storage		Remarks
						One time (ha-m)	Total (ha-m)	
Purba Bardhaman	<ul style="list-style-type: none"> ● Burdwan-II ● Monteswar ● Galsi – II 	Banka River	2	35 (av.)	70	26.25	26.25	Average height of dams 1.5 m
		Khari River	2	30 (av.)	60	22.50	22.50	
Hooghly	<ul style="list-style-type: none"> ● Singur ● Bhadreswar ● Mogra ● Balagarh ● Pandua 	Ghea River	1	60	60	22.50	22.50	Average height of dams 1.5 m
		Cut Kunti Channel	1	90	90	33.75	33.75	
		Soa Khal	1	60	60	42.50	42.50	
		Gangur Drainage Channel	2	50	100	37.50	37.50	
North 24-Parganas	● Swarupnagar	Ichhamati River	1	80	80	400.00	800.00	Major dam, height 5 m, replenishable storage
Paschim Medinipur	● Sabang	Kaliaghai River	1	150	150	600.00	1200.00	– do –
Total	–	–	11	–	670	1185.00	2185.00	–

7.3.2 Project Items

Various items of works would include but not be limited to the following:

- RCC work having a shape of 'U' trough across the channels for holding the rubber dams in position.
- Cement concrete apron in the upstream and downstream of the RCC floor of 'U' trough, with suitable sheet pile boxing below the trough and apron.
- Supply, fitting and fixing of the rubber dams inside the trough, with necessary anchorage arrangement.
- Compressor, centrifugal pumps and other electro-mechanical components for operation of the dams.
- RCC / chequered plate walkway on top of the dams for inspection and maintenance.
- River training and protection works by boulders / brick blocks / cement concrete.
- Cross bundhs for making the construction zone dry.
- Additional land (if rubber dams are constructed on virgin land) beside the flowing channel / river and finally connected to the main channel by excavating an arc-shaped new channel.
- Closure of embankment of main river / channel, in case rubber dams are constructed on newly excavated side channels, as stated above.

7.3.3 Estimated Cost and Assessment of Funding Gap

Available estimated cost of rubber dams already constructed in various other States have been collected and average cost per m² (i.e. length x maximum inflated height) has been calculated for small as well as large dams. These cost has suitable been indexed depending on the year of completion, to arrive at the cost as per present valuation. Finally, total cost has been arrived at by multiplying the cost per sqm with the area of the proposed dams, as shown below in Table – 5.0.

Table – 5.0

District	Type of rubber dams	No. off	Total length (m)	Max. height after inflation (m)	Area (m ²)	Cost per sqm for similar dams (Lakh of ₹/m ²)	Total estimated cost (₹ Crore)
Purba Bardhaman & Hooghly	Small	9 (4+5)	370	1.5	555	3.33	18.48
North 24-Parganas & Paschim Medinipur	Large	2	230	5.0	1150	10.00	115.00
Total	–	11	600	–	1705	–	133.48

Considering three years implementation period, total requirement of fund would be ₹ 133.48 crore. Further considering this as a pilot project, normal budgetary support may not be available, after making provisions for other committed schemes. As such, **the funding gap would be of ₹ 133.48 crore.**

7.3.4 **Project Benefits**

Creation of a total storage of 2185 ha-m would resultantly generate new irrigation potential of 4800 ha to be utilized for non-monsoon vegetables and Rabi crops. Other incidental benefits may be promotion of fishery and duckery, use of sweet surface water for domestic and other purposes, groundwater development and avoiding cost of desiltation works in tidal channels, in the upstream areas.

8.0 **Flood Management Sector**

8.1 **Rejuvenation, improvement and extension of flood management infrastructure in the districts of Darjeeling (SMP Area), Jalpaiguri, Alipurduar and Coochbehar (Project ID: IW/FM/1)**

8.1.1 **Rationale & Objectives**

The four northern districts of the State, i.e. Darjeeling, Jalpaiguri, Alipurduar and Coochbehar are criss-crossed by nearly seventy odd major, medium and minor rivers, having origin mostly in Nepal, Sikkim and Bhutan. A few of the important rivers are Mechi, Balason, Mahananda, Teesta, Karala, Dharala, Kaljani, Jaldhaka, Raidak I & II, Torsa and Sankosh. Almost all the rivers are known for carrying flash flood discharge during heavy rainfall, particularly in the upper catchment areas, together with huge sediment load in the form of boulders and pebbles, causing rising of bed level of the rivers, sometimes above the adjoining ground levels and leading to severe erosion, change of river course and avulsion of two adjoining rivers. Flood management infrastructure developed in these districts so far mainly include flood embankments built to protect important towns like Jalpaiguri, Alipurduar, Coochbehar, etc. and bank protective works to train the rivers and arrest erosion. Total length of rivers protected by the abovementioned interventions is around 1126.36 km in the said four districts, while the total unprotected river length in habitable areas and important locations is 600 km (approx.). With the growing population and increase in number of river dependent people for various sources of livelihood, the demand for protecting further stretches of the rivers either by embankments or by bank protection works or by both is increasing day by day, so as to minimize the damages to life and properties due to floods and river erosion. Floods are not new phenomenon in North Bengal areas which occur in some or other parts at an interval of 2 to 5 years, but the magnitude and devastation caused by the floods of August 2017, due to very heavy rainfall in upper catchment areas of the North Bengal rivers and also in West Bengal was exceptionally high, comparable with the highest flood experienced in the last couple of decades. In fact, ruling level of rivers were above Extreme Danger Level (EDL) at many

locations, e.g. for river Kaljani at Alipurduar Town, it was 1.25 m above EDL for quite a few days and the said level has set up new record of highest level ever achieved, surpassing the erstwhile Highest High Flood Level (HHFL) of 1993 floods by 0.8 m. Overtopping of embankments and other damages to the embankments as well as bank protective works occurred at numerous places. Town areas were waterlogged for prolonged periods. Keeping in view the colossal damage caused by the flood, it has become essential to have a thorough assessment of the severely damaged infrastructure and reconstruct the same after proper technical analysis, and redesigning embankments, if necessary, commensurate with the flood levels attained this year. It has also become necessary to further extend the protected area, particularly by constructing new girdle of embankments and bank protective works in densely populated areas, still lying unprotected to avoid large scale damage during future floods. A Consultancy Organization is being assigned with the task of preparation of a Detailed Project Report (DPR) in this regard, but preliminary assessment on locations and lengths of improvement of existing embankments, river training works as well as new embankments and new bank protective works have tentatively been made, for the purpose of analysis of infrastructure gap at this juncture, districtwise picture of which is summarized below in Table – 6.0. In case of Darjeeling District, the proposal has been kept restricted for Siliguri Mahakuma Parshad (SMP) areas, since remaining area is under the territorial jurisdiction of GTA.

Table – 6.0

District	Length of existing embankments to be improved (km)	Length of new embankments to be constructed (km)	Length of new bank protective works (km)	No. of deflectors / spurs for river training (No.)	Remarks
Darjeeling (SMP area)	39.4	23.6	62.0	164	Additional land required for construction of new embankment in Darjeeling, Jalpaiguri & Coochbehar is likely to be volunteered by the beneficiary population. However, land cost included within the estimated cost.
Jalpaiguri	112.1	22.4	75.5	136	
Alipurduar	13.0	0.0	48.0	0	
Coochbehar	49.0	7.0	293.0	14	
Total	213.5	53.0	478.5	314	

It needs to be mentioned here that length of various types of protection would be mutually overlapping. In other words, both improvement of embankments and bank protection works may be necessary at certain stretches. Similarly, construction of new embankments along with bank protection work may also be necessary at the same location.

8.1.2 Project Items

Various items of works would include:

- Earthwork for raising and strengthening of existing embankments and construction of new embankments with suitable provision for boulders, pebbles and shingles for armouring of embankments, wherever necessary.
- Loose boulder pitching / boulder in G.I. crates / boulder sausage etc. for bank protection works and deflectors, including spurs.
- Geo-synthetic Reinforced Wall (GRW), along with geo-bags, a new technical and viable alternative to conventional bank protective structures, made up of boulder, to be adopted in places where availability of adequate quantity and required size of boulders may be difficult.

8.1.3 Estimated Cost and Assessment of Funding Gap

Estimated cost for 4 major components, have been shown below districtwise in Table – 7.0.

Table – 7.0

District	Estimated cost for				Total Cost (₹ Cr)
	Embankment improvement (₹ Crore)	New embankments (₹ Crore)	Bank protection works (₹ Crore)	Deflectors / spurs for river training (₹ Crore)	
Darjeeling (SMP area)	59.90	46.64	95.17	4.30	206.01
Jalpaiguri	270.08	39.67	125.81	51.60	487.16
Alipurduar	12.46	0.00	112.14	0.00	124.60
Coochbehar	84.05	15.60	479.73	15.60	594.98
Total	426.49	101.91	815.85	71.50	1412.75
Grand Total	₹ 1412.75 crore				

However, considering 5 years implementation period and approximations assumed in the preliminary estimate, net financial involvement during the project implementation period has been taken as ₹ 1589 crore (₹ 1412.75 crore x 1.25 x 0.9). Budgetary availability during the said period with consideration of availability of 20% of total BE for flood management works in 2017-18 (i.e. 0.20 x ₹ 734 crore = ₹ 146.80 crore) and expecting the same to increase annually @ 15%, works out to ₹ 990.90 crore (₹ 146.80 crore x 5 x 1.35). Accordingly the **funding gap would be ₹ 598.10 crore** (₹ 1589 cross less ₹ 990.90 crore).

8.1.4 **Project Benefits**

Investment so far made on the flood management infrastructure in the said four North Bengal Districts was somewhat sporadic, scattered and often thinly spread. A holistic and comprehensive approach for preparation of a Master Plan for the entire area is going to be taken up after many decades, for overall assessment of the problems of floods and erosion in North Bengal and to suggest prioritized measures, befitting the perspective plan. Implementation of the project would have substantial positive impact on the livelihood of people of North Bengal. On the basis of preliminary assessment, areas adjoining rivers, including important townships to be directly benefitted due to minimization of flood losses of various kinds, viz. crop production, land, other private properties and public utilities etc. would be around 848 sqkm.

8.2 **Reconstruction and improvement of flood management infrastructure in the districts of Uttar Dinajpur, Dakshin Dinajpur and Malda (Project ID: IW/FM/2)**

8.2.1 **Rationale & Objectives**

The alluvial plains in the three central North Bengal Districts, i.e. Uttar & Dakshin Dinajpur and Malda were formed by river Ganga and its tributaries, and also various tributaries of river Brahmaputra. Important rivers criss-crossing the terrain, apart from Ganga, are Mahananda, Fulahar, Nagar, Tangon, Dauk, Sui, Punarbhaba, Brahmani, Atrai etc. Many of these rivers have embankments on either side. Embankment lines are however, discontinuous and there are circuit and town protective embankments at many places encircling low lying areas or along the periphery of important towns. Flooding and drainage congestion in these districts not only depend on local rainfall but also on the water levels of the main carrier rivers, i.e. Ganga, Teesta and Brahmaputra, which often rule very high due to carrying of heavy discharge from upper catchment areas in Nepal, Bihar, northern North Bengal Districts, Sikkim, Bhutan and Bangladesh. River erosion is also a major problem in these areas, mainly on Ganga and other rivers. Such erosion engulfs hundreds of hectare of lands. Existing flood management infrastructure in these districts was severely damaged due to remarkably high floods during August 2017, which were triggered due to very heavy local rainfall as well as exceptionally high ruling level of rivers carrying discharge from upstream areas. Breaches to embankments due to overtopping and reportedly unwarranted human interference from neighbouring State of Bihar occurred in many places, apart from damages of varying degree at numerous locations. Many of the rivers, including Mahananda, Sui, Atrayee, Punarbhaba, and Tangon were flowing above EDL for prolonged periods. Waterlogging in the protected as well as unprotected areas persisted for weeks. Taking a similar approach as adopted in case of the project for northern North Bengal Districts stated under Para 7.1 hereinbefore, a reputed Consulting Organization is being engaged to have a thorough assessment of the existing flood management infrastructure in these three districts, after carefully analyzing all flood and hydrological data and for suggesting remedial measures with a holistic approach. These measures

would be commensurate with the prevailing ground realities and implementable at worksites, so as to provide a reasonable degree of protection to the people in the flood prone areas in future. Although restoration works have already been taken up in the affected areas and a few of these have been completed, these are essentially palliative in nature and planned reconstruction and extension of the infrastructure are essentially required to add durability and required strength in the existing system. Based on preliminary assessment, districtwise plan for reconstruction and improvement of the main components of the flood management infrastructure has been broadly formulated for the purpose of gap analysis as shown in Table – 8.0 below.

Table – 8.0

District	Length of existing embankments to be improved (km)	Length of bank protection works (km)	Spurs / Deflectors	Drainage channel to be re-excavated (km)	Underground drainage network to be constructed (km)	New pump house (No.)	New culverts / bridges with widened waterway (No.)	New sluice structures (No.)
Uttar Dinajpur	72.00	23.00	0	0.00	0.00	0	0	10
Dakshin Dinajpur	53.00	17.00	0	0.00	0.00	0	0	4
Malda	175.00	64.60	6	28.0 (Refer Note-1)	1.75 (Refer Note-2)	1 (Refer Note-3)	7 (Refer Note-4)	14 (Refer Note-5)
Total	300.00	104.60	6	28.00	1.75	1	7	28

Note-1 : Details of channels

Offtake of river Kalindri at Block Manikchak (0.7 km), river Pagla (20 km), Link Channel of Chatra Beel in Englishbazar Municipality (3.30 km), near outfall of Pagla closure (4 km).

Note-2 : Underground conduit to link the open channel offtaking from Chatra Beel, to river Mahananda, within Englishbazar Municipality in connection with Laximpur Drainage Scheme.

Note-3 : In connection with Laximpur Drainage Scheme stated in Note-2 above.

Note-4 : In connection with Laximpur Drainage Scheme (5 nos.) and improvement of Pagla river (2 nos.)

Note-5 : 13 sluices of average capacity of 1.3 cumec on various channels and 1 major regulator at Pagla river closure point, in replacement of the existing earthen closure embankment.

Construction of new embankments has not been considered for the time being as procurement of additional land would be extremely difficult, if not impossible. Also Ganga erosion has been considered under a separate project.

8.2.2 Project Items

Possible items of works would include but not be limited to the following:

- Earthwork for raising and strengthening of existing embankments with suitable provisions for armouring wherever required.
- Boulder pitching (loose) or in G.I. crates, sausages and geo-bags for bank protection and deflectors.
- RCC / PCC, brickwork, reinforcement, structural steel works, electro-mechanical works etc. required for construction of bridges, pump houses and other hydraulic structures.

8.2.3 Estimated Cost and Assessment of Funding Gap

Districtwise estimated cost of various components, including the already formulated part schemes (for drainage improvement) in Malda is shown below in Table – 9.0.

Table – 9.0

District	Estimated cost for				Total Cost (₹ Cr)
	Embankment improvement (₹ Crore)	Bank protection works including spurs/deflectors (₹ Crore)	New sluice structures (₹ Crore)	Major drainage improvement works, having details of components (₹ Crore)	
Uttar Dinajpur	78.00	59.00	1.50	0.00	138.50
Dakshin Dinajpur	54.00	56.00	0.40	0.00	110.40
Malda	235.50	202.10	2.60	82.12 (Refer Note-1)	522.32
Total	367.50	317.10	4.50	82.12	771.22

Note-1: Kalindri river offtake: ₹ 0.70 crore, Pagla river improvement: ₹ 10.00 crore, Laximpur Drainage Scheme: ₹ 50.61 crore, Regulator and ancillary works at Pagla river closure: ₹ 20.81 crore, Total = ₹ 82.12 crore.

Considering 3 year implementation period, net requirement of fund is ₹ 771.22 crore. As against this, funds to be made available on the basis of availability of 10% of total BE of 2017-18 in flood management sector in the 1st year and considering 15% annual growth at every year is ₹ 255.43 crore (3 x 0.1 x ₹ 734 crore x 1.16). Accordingly the **funding gap would be of ₹ 515.79 crore** (₹ 771.22 cross less ₹ 255.43 crore).

8.2.4 Project Benefits

There would be minimization of flood loss and additional yield due to better drainage in the benefitted area, which has been assessed as 1952 sqkm.

8.3 **Anti-erosion and river training works of critical stretches on rivers Ganga-Padma and Bhagirathi in the districts of Malda, Murshidabad and Nadia (Project ID: IW/FM/3)**

8.3.1 **Rationale & Objectives**

Severe erosion on Ganga-Padma river system has engulfed nearly 2800 hectare of land in Malda, Murshidabad and Nadia Districts during last 12 years. Monetary value of land losses and other losses of public assets like roads, community buildings, places of worship and private properties including orchards, buildings, hutments, etc. has been assessed as close to ₹ 1000 crore, taking into consideration erosion caused by river Bhagirathi in Murshidabad and Nadia Districts, together with Ganga-Padma erosion. Such erosion may primarily be attributed to the change of river morphology triggered by the construction of Farakka Barrage, both in upstream and downstream areas, forming shoals near one bank and erosion on the opposite bank. In this context and considering the international aspect of Ganga-Padma erosion, it was decided in 2005 by the MoWR, RD & GR, Gol, in consultation with the State Government, to extend original jurisdiction of Farakka Barrage Project (FBP) Authority (from 11.5 km upstream to 5.9 km downstream) upto 40 km in the upstream of the Barrage to 80 km downstream, in respect of taking up of bank protection works. However, FBP Authority practically did not take up the works to the required extent. Very recently, the MoWR, RD & GR, Gol conveyed withdrawal of their early decision of 2005 and restored their original jurisdiction for this purpose, without any consultation with the State Government. The State Government has taken up the said issue at the highest level in Gol for immediate rescinding of the decision, to fulfill the earlier commitment of Gol for undertaking anti-erosion works on the entire stretch of Ganga-Padma over a length of 120 km. However, no response has been received from the Gol till now and it appears that onus of undertaking anti-erosion works to save lives and properties of thousands of people is now entirely on the State Government. So far as the river Bhagirathi is concerned, which has been declared as National Waterway-I, the problem of bank erosion has further been aggravated due to wave dash during movement of coal carrying barges. List of erosion affected spots on river Bhagirathi in Murshidabad, Nadia and other districts was handed over to IWAI, and joint site visits were also held with that Authority to identify and visualize the impact of erosion. However, no concrete action has yet been taken by that Authority. Accordingly, the instant project proposal has been formulated to take up properly designed bank protection works on Ganga-Padma for a length of 32.45 km and on Bhagirathi for a length of 42.60 km, in the districts of Malda, Murshidabad and Nadia to minimize further damage due to erosion, which is continuing unabated. District-wise and river-wise picture is shown below in Table – 10.0.

Table – 10.0

District	Ganga-Padma erosion			Bhagirathi erosion		Name of Blocks having affected areas	Extent of area to be protected (ha)	Remarks
	No. of affected spots (No.)	Length of eroding bank to be protected (km)	No. of river training works (spur) (No.)	No. of affected spots (No.)	Length of eroding bank to be protected (km)			
Malda	5	15.10	1	0	0.00	<ul style="list-style-type: none"> ● Manikchak ● Ratua-I ● Kaliachak – II & III 	320	–
Murshidabad	27	16.85	2	41	27.15	<ul style="list-style-type: none"> ● Farakka ● Dhuliyani Municipality ● Samserganj ● Suti – I & II ● Lalgola ● Raghunathganj – I & II ● Bhagabangola – II ● Raninagar – II ● Jalangi ● Sagardighi ● Murshidabad-Jiaganj ● Berhampore ● Beldanga – I & II 	515	Out of total area of 961 ha to be protected from erosion, 565 ha pertains to Ganga-Padma and remaining 396 ha to Bhagirathi.
Nadia	1	0.50	0	20	15.45	<ul style="list-style-type: none"> ● Karimpur – I ● Kaliganj ● Nakashipara ● Krishnanagar – II ● Nabadwip ● Shantipur ● Ranaghat – I ● Chakdah 	126	
Total	33	32.45	3	61	42.60	–	961	–

8.3.2 Project Items

Various items of works of the project would include but not be limited to the following:

- Geo-bag / HDPE sand bags / normal polybag for filling up of scour holes in riverbed / boulder sausage apron to function as launching apron against anticipated scour, below Low Water Level or intermittent cylindrical sausages with boulders.
- Loose boulder pitching / geo-bag pitching / normal polybag pitching above Low Water Level.
- Crated boulders in sausages for toe wall or for spurs.
- Porcupine spurs as flow deflectors, particularly in Bhagirathi River.

8.3.3 Estimated Cost and Assessment of Gap Funding

Estimated cost of the project has been calculated separately for Ganga-Padma and Bhagirathi and shown district-wise in the following Table – 11.0.

Table – 11.0

District	Estimated Cost for		Total Cost (₹ Crore)
	Ganga-Padma erosion (₹ Crore)	Bhagirathi erosion (₹ Crore)	
Malda	212.50	0.00	212.50
Murshidabad	262.50	149.50	412.00
Nadia	7.00	85.00	92.00
Total	482.00	234.50	716.50

Considering five years implementation period in view of the time required for procuring huge quantity of construction materials, net financial involvement during the project implementation period would be ₹ 895.63 crore (₹ 716.50 crore x 1.25). As against this, likely availability of normal budgetary funds considered is 'nil' as no provision for these works are normally considered in the Core State Plan or RIDF in conformity with the demand of 100% central funding for these works. Accordingly, the **funding gap would be of ₹ 895.63 crore.**

8.3.4 Project Benefits

Implementation of the project would protect 961 ha of land from the imminent threat of erosion and would save public utilities and private assets worth ₹ 1725 crore.

8.4 Ghatal Master Plan (Phase-I Works) in Paschim & Purba Medinipur Districts (Project ID: IW/FM/4)

8.4.1 Rationale & Objectives

Recurring floods, combined with drainage congestion in large part of Ghatal Subdivision and adjoining areas in the districts of Paschim and Purba Medinipur wrought the economy of the area, and has greater affected of the area and has stunted the lives of inhabitants and the development of the infrastructure in the area. The project area is criss-crossed by a number of rivers and their tributaries & distributaries and also man-made drainage channels have old embankments either on one or both sides, which have become weak and vulnerable. Large areas in Daspur – I & II & Ghatal Blocks were waterlogged for days during the floods of August 2017. Suffering from the handicap of being located at the downstream end of three major river sub-basins, i.e. Kangsabati, Silabati and Dwarakeswar and having a very flat terrain slope with low level pockets, easement of

drainage congestion in the area has always been a major challenge. Confronted with this challenge, the I&WD, after making detailed field survey and conducting mathematical model study by IIT Kharagpur, prepared a DPR of the Phase-I works, at an estimated cost of ₹ 1214.92 crore. The DPR was cleared from techno-economic angle by the Advisory Committee of MoWR, RD & GR, GoI in May 2015 and then it was posed for investment clearance by the said Ministry, a pre-requisite for executing the project under centrally assisted Flood management Programme (FMP) with sharing of cost between the Central and State Government in the ratio of 50 : 50. Unfortunately, even after according techno-economic clearance, series of observations mainly related to disposal of earth to be obtained from re-excavation of rivers and channels, and becoming excess after formation of embankments on both the sides of rivers / channels, and also on other issues, were raised by the empowered inter-Ministerial Committee of the MoWR, RD & GR, GoI on several occasion during last two years. Compliance of observations has been made diligently as and when these were communicated to the State Government, the last reply was sent in October 2017. Meanwhile, there has been revision in cost due to change of SoR and the latest estimated cost is ₹ 1238.95 crore, which is 2% above the previous cost. It is also to be mentioned here that considering the urgency of the project, the GoI has been requested by the State Government at the highest levels but there has so far been no positive response. It is apparent that there is little likelihood of Central Government of the clearance of this project. Accordingly, the project is included in the infrastructure gap analysis with the objective of implementing it out of additional resources. Salient features of the projects are shown below in Table – 12.0.

Table – 12.0

Sl. No.	Description	Length in km / No.
1.	Re-excavation of rivers and channels, i.e. old and New Cossyee river, Kanki river, Silabati river, Palaspai, Durbachati, Chandreswar and Solatopa Khal, and improvement / reconstruction of appurtenant embankments.	147 km
2.	Construction of pump houses at Ghatal Municipal area.	2 Nos.
3.	Construction of major regulators at outfall on Narayani Khal and on Kanki river.	2 Nos.
4.	Retaining wall like structure on left bank of Silabati to protect Ghatal Municipal area from flood spill.	2 km
5.	Widening of waterway of existing bridge and construction of new bridge.	2 Nos.
6.	Cluster of works in Kherai-Buxi Drainage Scheme.	1 No.
7.	Restoration of erstwhile abandoned Ghatal Circuit Embankment.	16 km
8.	Improvement of right embankment of Kangsabati river at selective stretches.	
9.	Construction of dwarf wall on top of embankment, where raising of embankment is not feasible.	148 km
10.	Procurement of land by direct purchase through Paschim Medinipur Zilla Parishad.	20 ha

8.4.2 Project Sub-heads / Items and Estimated Cost

Latest estimated cost as per the DPR is shown below in Table – 13.

Table – 13.0

Sl. No.	Name of Sub-Heads / Items	Amount (₹ Cr.)
1.	A – Preliminary (Survey, Soil Testing and other preparatory measures)	35.25
2.	B – Land procurement	62.73
3.	C – Works (cross bundhs at outfall location of rivers for dry re-excitation, retaining wall like structure by stepped boulder sausage, dwarf wall)	64.55
4.	D – Regulator	11.64
5.	F – Cross Drainage Works (sluices and pump houses and works on Kherai-Buxi system)	65.98
6.	G – Bridges	14.77
7.	K – Buildings	0.00
8.	L – Earthwork for re-excitation of drainage channels and making embankments	957.70
9.	M – Plantation	0.20
10.	O – Miscellaneous	12.13
11.	P – Maintenance during construction	11.15
12.	Losses on stock	2.85
Total Estimated Cost (Latest)		1238.95

8.4.3 Analysis of Funding Gap

Considering 4 year implementation period for the project, total requirement of fund has been assessed equal to the estimated cost, i.e. ₹ 1238.95 crore. As against this, the availability of normal budgetary funds, has been taken as nil, as the project was always considered for implementation under central funding. Accordingly, the **funding gap would be of ₹ 1238.95 crore.**

8.4.4 Project Benefits

Implementation of Phase-I of Ghatal Master Plan would benefit 657 sqkm of area in the districts of Paschim & Purba Medinipur and the monetary value of annual benefit due to minimization of flood losses would be to the tune of ₹ 288 crore.

8.5 Raising, strengthening and improvement of flood embankments owned and maintained by the I&W Department in 12 South Bengal Districts, i.e. Murshidabad, Birbhum, Nadia, Paschim & Purba Bardhaman, Paschim & Purba Medinipur, Jhargram, Hooghly, Howrah, North & South 24-Parganas (Project ID: IW/FM/5)

8.5.1 Rationale & Objectives

The abovesaid 12 South Bengal Districts mostly lie in 25 river sub-basins of Ganga basin, along with a fractional area lying in Subarnarekha basin. Out of total 49,971 sqkm of geographical area of these 12 districts, nearly 50% area (24,892 sqkm) has been identified as flood prone, suffering from waterlogging and drainage congestion due to local rainfall, as well as huge discharge carried by major rivers, i.e. Ganga-Padma, Bhagirathi, Mayurakshi, Ajoy, Damodar, Kangsabati, etc. from upper riparian States, which either spills in unembanked areas or affect the protected areas, by overtopping or breaching of river embankments. It may be mentioned here that there is a long history of construction of riverine and sea facing embankments for land reclamation and flood protection, by various private and government entities, starting in early British period. These embankments were mostly earthen, constructed by using local soil, with little attention on technical aspects in case of embankments constructed by local landlords. Subsequently, onus of maintenance of around 9,131 km length of embankment was transferred to the I&W Department, mostly after independence and since then the Department is continuously engaged in raising, strengthening and adding durability to the embankments by various structural interventions, within the extent of available funds, apart from constructing new embankments with properly designed profile. Keeping in view the increase in frequency and magnitude of major floods affecting these areas, rising of bed levels in the main carrier rivers and increasing population density resulting in occupying flood plains for livelihood, improvement of flood embankments, a major structural measure of flood management has become essential. It has already been stated in Para 5.0 that rehabilitation and improvement of 2,614 km length of embankment during last six years has been taken up by implementation of major flood management projects, i.e. Kaliaghai-Kapaleswari-Baghai Basin Drainage Scheme, Sundarban Embankment Reconstruction Project, Kandi Master Plan, etc. and numerous small schemes to address the localized problems, and majority of the works were in these districts. Improvement / construction of 318 km length of embankment has also been targeted during implementation of another project, i.e. Ghatal Master Plan, as detailed in Para 8.4.1. However, there is full substantive infrastructure gap necessitating formulation of this project. It has been primarily assessed that further 518 km length of embankment, excluding the embankments considered under ongoing Kandi Master Plan in Birbhum & Murshidabad, approved “West Bengal Major Irrigation and Flood Management Project” in Purba & Paschim Bardhaman, Hooghly & Howrah and the proposed Ghatal Master Plan in Purba & Paschim Medinipur, balance infrastructure requirement in the said 12 Districts is as shown below in Table – 14.0.

Table – 14.0

Sl. No.	District	Length of embankment considered for raising, strengthening and improvement (km)	Likely benefitted area from flood spilling / waterlogging (sqkm)
1.	Murshidabad	69.0	282.0
2.	Birbhum	35.0	70.0
3.	Nadia	18.5	92.0
4.	Paschim Bardhaman	3.5	12.0
5.	Purba Bardhaman	69.5	263.0
6.	Paschim Medinipur	37.0	106.0
7.	Purba Medinipur	180.0	1000.0
8.	Jhargram	6.0	18.0
9.	Hooghly	30.7	255.0
10.	Howrah	11.0	69.0
11.	North 24-Parganas	19.6	264.0
12.	South 24-Parganas	38.0	165.0
Total		517.8	2596.0
Say		518.0 km	–

8.5.2 Project Items

Various items of works include the following:

- Earthwork for embankment by local / transported earth (where good quality of local earth is not available).
- Armouring of river / sea side of the embankment by dry brick pitching / brick block pitching / cement concrete block pitching over a layer of conversional / geo-synthetic filter, along with toe wall and apron like structures.

8.5.3 Estimated Cost and Assessment of Funding Gap

Estimated cost for improvement of the embankments has been worked out at district level by the field level officials of the I&W Directorate. Some variations are there in cost per unit length due to difference in prevailing condition, existing as well as designed section of the embankments. A summary list showing districtwise estimated cost of improvement is shown below in Table – 15.0.

Table – 15.0

Sl. No.	District	Estimated Cost for restoration of embankment (₹ Crore)
1.	Murshidabad	41.50
2.	Birbhum	34.50
3.	Nadia	7.50
4.	Paschim Bardhaman	9.50
5.	Purba Bardhaman	52.20
6.	Paschim Medinipur	23.00
7.	Purba Medinipur	100.00
8.	Jhargram	3.00
9.	Hooghly	38.50
10.	Howrah	19.00
11.	North 24-Parganas	91.40
12.	South 24-Parganas	250.00
Total		670.10

Considering a project implementation period of three years, total requirement of fund is ₹ 670.10 crore, and no escalation needs to be considered. As against this, the likely availability of normal budgetary funds, considering 15% of the total BE for flood management works in 2017-18, i.e. ₹ 110.10 crore (0.15 x ₹ 734.00 crore) and expecting the same to increase annually @ 15%, becomes ₹ 383.15 crore (₹ 110.10 crore x 3 x 1.16). Accordingly, the **funding gap would be of ₹ 286.95 crore** (₹ 670.10 cross less ₹ 383.15 crore).

8.5.4 Project Benefits

Improvement of embankments will provide the following benefits in around 2,596 sqkm of area in the 12 South Bengal Districts:

- Minimization of flood relating to agriculture, public utilities and private assets, by protecting the embankments from breaching and overtopping.
- Securing active communication link during periods of calamities, for transportation of relief materials and evacuating affected people.
- Providing temporary shelter for accommodating affected people during waterlogging in the countryside.

8.6 **Improvement of Ex-zamindary embankments in 11 Districts, i.e. Uttar & Dakshin Dinajpur, Malda, Murshidabad, Birbhum, Purba & Paschim Bardhaman, Purba & Paschim Medinipur, Hooghly & Howrah (Project ID: IW/FM/6)**

8.6.1 **Rationale & Objectives**

Genesis of construction of embankments by local landlords (known as Zamindars) during the pre-independent period has already been explained in Para 8.5.1. While a part of the embankments was transferred to the I&W Department after independence, Panchayat Authorities under the 3-tier Panchayati Raj System were maintaining majority of these embankments. Initially these were of lesser importance, in the context of demographical and geophysical characteristics of the areas protected by them, but with the passage of time and consequent upon growing population demand and change in land use pattern, these embankments have become essential part of the crucial flood management infrastructure, as breaches and overtopping of these embankments cause heavy damages to the life and property of local inhabitants. The embankment sections were seldom properly designed. Moreover, improvement of this embankment by raising and strengthening is another critical and sensitive issues in cases where I&WD embankments are located in the opposite bank of river or in nearby areas, as too much raising of the Ex-zamindary embankment would prevent spilling altogether, causing unwarranted rise of water in river valley section, which may adversely affect the I&WD embankments, which are protecting much more densely populated and important areas. So a careful tradeoff is necessary in fixing the height of these Ex-zamindary embankments. In the context of above, and further considering the lack of adequate technical expertise in the local Panchayat Authorities, it has been decided by the State Government to transfer the ownership and responsibility of maintenance of all Ex-zamindary embankments to the I&W Department. The detailed inventory of these embankments in different districts is, however, yet to be provided by the Panchayat & Rural Department. The field level Executive Engineers have collected the list of these Ex-zamindary embankments from the Panchayat Authorities / District Administration wherever possible and made a rough assessment of the existing condition of these embankments. The basic design principles followed in connection with improvement of these embankments are as follows:

- i) Height of embankment should be able to cater for medium floods, but it should always be less than the flood embankments originally maintained by the I&WD, either in vicinity of the Ex-zamindary embankments or on the opposite bank of rivers / channels. Base width and side slope of the embankments should be commensurate to the height, as per standard practice.
- ii) In cases where there are chances of overtopping of flood water, due to restriction in height of the embankments, suitable stretches (individual stretch with varying from 30 m to 300 m) of these embankments would be identified, preferably near adjoining secondary and tertiary drainage channels, and height of embankment in these

stretches would be further lowered than the general height adopted, to allow guided and controlled spilling of flood water into the countryside at these locations, which would ultimately be drained through the nearby drainage channels.

- iii) Embankment section in these spilling zones would be fully shielded and covered with cement concrete, along with adequate toe protection, by cut-off wall, apron and also energy dissipating friction blocks, particularly on the countryside, so that no damage takes place to the embankments during spilling of flood water in these stretches.
- iv) On the basis of preliminary assessment length of these spilling zones is considered to be around 10% of total length on an average.

Improvement of scientific interventions, supported by proper design considerations, would minimize the damages to these embankments and also reduce the extent and duration to some extent, even in cases of major floods. Districtwise length of Ex-zamindary embankments to be improved for normal condition as well as to be treated for special protection stated above and the likely extent of benefitted area is shown below in Table – 16.0.

Table – 16.0

Sl. No.	District	Total length of Ex-zamindary embankments to be improved as per preliminary assessment (km)	Length considered for normal improvement (km)	Length considered for special protection including total shielding of embankments in predetermined spilling zone (km)	Likely benefitted area (sqkm)
1.	Uttar Dinajpur	6.0	5.5	0.5	7.2
2.	Dakshin Dinajpur	8.1	7.5	0.6	9.7
3.	Malda	42.0	40.0	2.0	50.4
4.	Murshidabad	9.9	8.6	1.3	12.0
5.	Birbhum	24.1	21.7	2.4	26.5
6.	Purba & Paschim Bardhaman	130.0	117.0	13.0	195.0
7.	Paschim Medinipur	63.0	57.0	6.0	88.2
8.	Purba Medinipur	57.0	50.0	7.0	91.2
9.	Hooghly	95.0	86.0	9.0	171.0
10.	Howrah	81.0	72.9	8.1	162.0
Total		516.1	466.2	49.9	813.2
Say : 813.0 sqkm					

8.6.2 Project Items

Various items of works include the following:

- Earthwork for embankment by local soil.
- Armouring of river side slope by boulder / cement concrete block pitching in the riverside slope, wherever required.
- Cement concrete with nominal reinforcement for shielding the embankment totally in spilling zones along with friction blocks on the side slopes.
- Boulder / concrete apron with concrete / masonry / sheet pile toe wall, in the countryside.

8.6.3 Estimated Cost and Assessment of Funding Gap

As done for I&WD embankments, field level officials of the I&W Directorate, worked out the estimated cost, both for normal improvement as well as in the spilling zone, on the basis of rough assessment. Districtwise summary list is shown below in Table – 17.0.

Table – 17.0

Sl. No.	District	Estimated cost for normal improvement (₹ Crore)	Estimated cost for special protection in the predetermined spilling zones (₹ Crore)	Total estimated cost (₹ Crore)
1.	Uttar Dinajpur	4.00	2.00	6.00
2.	Murshidabad	2.60	5.20	7.80
3.	Malda	2.40	1.50	3.90
4.	Birbhum	23.10	6.00	29.10
5.	Purba & Paschim Bardhaman	117.00	45.50	162.50
6.	Paschim Medinipur	57.00	12.00	69.00
7.	Purba Medinipur	50.00	14.00	64.00
8.	Hooghly	215.00	36.00	251.00
9.	Howrah	110.00	29.00	139.00
Total		581.10	151.20	732.30

Considering a project implementation period of three years, the total requirement of fund will be ₹ 732.30 crore and no escalation needs to be considered. As against this, no normal budgetary fund is likely to be available, in view of other commitments, and further considering the fact that these embankments were not included earlier in the list of assets of the I&W Department. As such, the **funding gap would be of ₹ 732.30 crore.**

8.6.4 **Project Benefits**

There would be considerable reduction of extent as well as duration of flood related inundation in the benefitted areas, assessed as 813 sqkm in 11 districts, by scientific improvement of these embankments. As a result, extent of damages to crop production, public utilities and properties and also private assets, would be reduced considerably, due to reduction of number of breaches, even during major floods. However, all the damages cannot be avoided altogether due to spilling of water into the countryside, particularly during high floods, but these would take place at predetermined and identified locations, so affected people could be made aware well in advance.

8.7 **River bank protection works in 10 South Bengal Districts, i.e. Bankura, Birbhum, Paschim & Purba Medinipur, Jhargram, Paschim & Purba Bardhaman, Hooghly Howrah & South 24-Parganas and Coastal protection works in Purba Medinipur District** (Project ID: IW/FM/7)

8.7.1 **Rationale & Objectives**

River / sea erosion is a result of interaction between the forces generated by river / sea hydrodynamics and soil or earth from the bank line. River erosion in various South Bengal Districts and the above mentioned 10 districts in particular, is attributable to the following main reasons:

- a) Meandering flow of rivers resulting in sharp bank curvatures, affecting flow dynamics in such a way so as to cause erosion on the concave bank and consequent deposition in the opposite convex bank.
- b) Rapid depletion of water stage, particularly during passage of high floods.
- c) Wave dash due to navigation.
- d) Soil characteristics, particularly presence of cohesion less sandy loam or moorum soil in western districts and silty loam / stratified fine sand / clayey silty loam in other districts.

Erosion in various major rivers flowing through these Districts, viz. Dwarakeswar, Silabati, Kangsabati, Ajoy, Damodar, Mayurakshi, Subarnarekha, Bhagirathi-Hooghly, Rupnarayan, Haldi etc. and numerous creeks criss-crossing Sundarban area, is a perennial and major problem, since long. The challenge of tackling the problem, due to the dynamic pattern and unpredictable nature of erosion cannot be perhaps anticipated beforehand, even by mathematical model. Hence, formulation of a long term master plan is a rather difficult proposition. It is not possible, neither feasible to undertake anti-erosion works at all places, because of the cost prohibitiveness and possible impact of the protected zone on immediately upstream and downstream reaches. However, habitable areas and other vulnerable areas, where erosion is continuing unabated and people are losing land and

other assets for a prolonged period, need to be attended. The I&W Department has already undertaken around 252 km of anti-erosion works in the said districts. Gap still exists and strong demands are there to undertake critically vulnerable spots in different districts. The gap length as per present ground condition is 273.2 km in the said 10 districts. Total coastal length in Purba Medinipur District is 67 km, out of which around 13.4 km length in Digha-Shankarpur and adjoining areas, starting from Udaypur, Bengal-Orissa border in the west upto Jalda in the west is critical from the point of view of sea erosion. A total stretch of length 10.6 km has already been protected from sea erosion in this area, leaving a gap of 2.8 km. It is to be mentioned here that flood is a declared natural calamity in terms of prevailing norms of disaster management and there is a scope of providing relief and compensation to the flood affected people from SDRF / NDRF. However, 14th Finance Commission, inspite of specific demand of the State Government did not include river / sea erosion in the list of calamities, on the ground of state specific nature of the problem. In that way, erosion victims are sort of deprived as there is little scope to readily offer them compensation / relief from the SDRF / NDRF. Therefore, considering the plight of these people, mostly agriculturalists, artisans, daily wage earners or self employed small businessmen, anti-erosion projects deserve implementation with due priority. However, in case of coastal protection works in Digha Shankarpur area, the prime reason is to secure the coastline and to protect the tourism infrastructure. Depending on rapid field assessment, districtwise vulnerable and eroding length of river banks and sea coasts has been identified and area to be protected from erosion has also been calculated as shown in Table – 18.0 below.

Table – 18.0

Sl. No.	Districts	Present length of eroding bank (km)	No. of river training works (spurs / deflectors)	Eroding coastal length along sea breach (km)	Total length (km)	Benefitted area after implementation of anti-erosion works (ha)	Main river causing erosion
1.	Bankura	45.9	370	0.0	45.9	10700	<ul style="list-style-type: none"> ● Damodar ● Dwarakeswar ● Gandheswari ● Silabati ● 7 other rivers
2.	Birbhum	5.4	0	0	5.0	1500	<ul style="list-style-type: none"> ● Ajoy
3.	Paschim Medinipur	17.8	118	0.0	17.8	3900	<ul style="list-style-type: none"> ● Kangsabati ● Silabati ● Subarnarekha ● 5 other rivers
4.	Purba Medinipur	40.0	0	2.8	42.8	10000	<ul style="list-style-type: none"> ● Rupnarayan ● New Cossye ● Pianskhali ● 10 other rivers

Table – 18.0 (Contd.)

Sl. No.	Districts	Present length of eroding bank (km)	No. of river training works (spurs / deflectors)	Eroding coastal length along sea breach (km)	Total length (km)	Benefitted area after implementation of anti-erosion works (ha)	Main river causing erosion
5.	Jhargram	19.8	101	0.0	19.8	3900	● Subarnarekha ● Dulung ● Cossyee
6.	Paschim Bardhaman	2.1	0	0.0	2.1	600	● Damodar
7.	Purba Bardhaman	99.2	550	0.0	99.2	24700	● Bhagirathi ● Damodar ● Dwarakeswar
8.	Hooghly	3.7	0	0.0	3.7	1200	● Dwarakeswar
9.	Howrah	2.3	0	0.0	2.3	3000	● Rupnarayan ● Hooghly ● 2 other rivers
10.	South 24-Parganas	37.0	504	0.0	37.0	23800	● Matla ● Bidya ● Muriganga ● 29 other rivers
Total		273.2	1643	2.8	275.6	83300	–
Say : 833 sqkm							

8.7.2 Project Items

Various items of works include the following:

- Boulder sausage / cement concrete apron.
- Boulder sausage / brick / cement concrete toe wall at low water level with or without sheet pile cut-off wall.
- Semi permeable bullah cage with boulder filled or porcupine or trapezoidal crated boulder spurs.
- Boulder / brick block / cement concrete pitching above low water level with conventional / geo-synthetic filters.
- Geobags / Geotubes.

8.7.3 Estimated Cost and Assessment of Funding Gap

Estimated costs have been worked out at district levels by the field level officials of the I&W Directorate as shown below in Table – 19.0.

Table – 19.0

Sl. No.	District	Cost for		Total estimated cost (₹ Crore)
		Riverbank protection works (₹ Crore)	Coastal protection works (₹ Crore)	
1.	Bankura	104.00	0.00	104.00
2.	Birbhum	16.20	0.00	16.20
3.	Paschim Medinipur	57.10	0.00	57.10
4.	Purba Medinipur	92.50	75.50	168.00
5.	Jhargram	45.80	0.00	45.80
6.	Paschim Bardhaman	17.90	0.00	17.90
7.	Purba Bardhaman	592.70	0.00	592.70
8.	Hooghly	8.60	0.00	8.60
9.	Howrah	7.60	0.00	7.60
10.	South 24-Parganas	160.10	0.00	160.10
Total		1102.50	75.50	1178.00

Considering a project implementation period of three years, total requirement of fund will be ₹ 1178 crore and no escalation needs to be considered. As against this, the likely availability of normal budgetary funds, considering 20% of the total BE for flood management works in 2017-18, i.e. ₹ 146.80 crore (0.20 x ₹ 734 crore) and expecting the same to increase annually @ 15%, becomes ₹ 510.86 crore (₹ 146.80 crore x 3 x 1.16). Accordingly, the **funding gap would be of ₹ 667.14 crore** (₹ 1178 cross less ₹ 510.86 crore).

8.7.4 Project Benefits

Implementation of the project would protect 83,300 ha (833 sqkm) of land from the imminent threat of erosion and would save public utilities and private assets worth thousands of crore.

8.8 Rejuvenation and improvement of the drainage infrastructure in 10 South Bengal Districts, i.e. Nadia, Bankura, Paschim & Purba Bardhaman, Paschim & Purba Medinipur, Hooghly, Howrah and North & South 24-Parganas (Project ID: IW/FM/8)

8.8.1 Rationale & Objectives

The abovesaid districts of South Bengal have flood prone areas, measuring around 18,470 sqkm, which is 36% of the total geographical areas of the abovesaid districts. The area mostly lying in Gangetic alluvial plains with very flat terrain slope and partially in the flatter

part of western plateau, is criss-crossed by many major rivers, e.g. Hooghly-Bhagirathi, Jalangi, Churni, Ajoy, Damodar, Kangsabati, Silabati, Dwarakeswar, Rupnarayan, Haldi and as well as numerous local drainage channels and also creeks in Sundarban areas, serving as tributaries and distributaries to the main rivers. The issue of improvement of embankments, a major tool of structural flood management in these areas has already been covered in Paras 7.7 and 7.6 hereinbefore. However, in addition to improvement of embankments, re-excavation of various important drainage rivers and channels has also been identified as an essentially required measure for flood management in these areas. Such reexcavation works are to be carried out at periodic intervals, to mitigate the chronic problem of siltation in the channels and selected stretch of rivers, so as to restore and improve the carrying capacities of the rivers and channels. Siltation takes place due to various reasons, including ingress of tidal water in lower reaches of the channels, in the tidal zones, loss of soil mass during heavy rainfall particularly in the western plateau, or due to excessive urbanization and consequent human interference in town areas within and closer to Kolkata Metropolitan Areas. Apart from desiltation of drainage channels, other structural interventions necessary to minimize the duration and extent of inundation in these areas, are improvement / new construction of various control / regulating structures for channelizing and streamlining the flow, lining of drainage channels at critical stretches within city limits and installation of new pump houses as well as augmentation of capacity of existing pump houses. It has been observed that changes in land use pattern due to rapid urbanization is increasing the extent of paved area, minimizing overland flow, and giving rise to a situation, where gravity flow through the channels cannot cater to the requirement. Tidal lockage period at the outfall locations further aggravates the problem and pumped discharge has to be taken up to provide quicker relief from drainage congestion. Requirement of implementation of various components, depending on the prevailing field conditions and also after taking into consideration the works already executed in recent past under various major schemes and also as a part of major drive to revamp the drainage system in Kolkata and adjoining districts of Hooghly, Howrah, North & South 24-Parganas, has been assessed districtwise as critical infrastructure gaps, and has been shown in Table 20.0 on the next page. While doing the exercise, the interventions already included in the ongoing / approved / upcoming other projects considered in the Gap Analysis, have been excluded. It may further be mentioned that floods affecting more than 2000 sqkm area have occurred in these districts, on as many as 22 occasions during the last 40 years, further justifying the cause of taking up planned projects for drainage improvements, in continuation of the ongoing activities. It is further to be mentioned that floods and drainage congestion, apart from causing direct losses to agricultural production, assets, properties and utilities have a number of indirect adverse impacts, like loss of man-days of working class people and daily wage earners, increase in water and vector-borne diseases, thereby consuming a considerable part of family income of the affected persons due to increase in cost for medical treatment and also other social losses and environmental degradations.

Table – 20.0

Sl. No.	District	No. of rivers / channels considered for desiltation / lining / construction of regulating structures/pump houses etc.	Length of drainage channels to be re-excavated (km)	Likely volume of excavated materials		Length of channel to be lined by cement concrete blocks (km)	Major sluices / regulators including outfall sluices by new construction / augmentation		Field inlets (new or augmentation)		Pump houses (new or augmentation of capacities)		Total benefitted area due to all interventions (sqkm)
				By dry excavation using machines (cum)	By wet excavation using pontoon mounted excavators in flowing water (cum)		No.	Total capacity to be installed (cumec)	No.	Total capacity to be installed (cumec)	No.	Total capacity to be installed (cumec)	
1.	Nadia	8	0.0	0	0	0.0	8	1085.78	2	22.65	0	0.00	250
2.	Bankura	2	30.7	12,24,000	0	0.0	0	0.00	0	0.00	0	0.00	87
3.	Paschim Bardhaman	2	15.5	5,20,000	0	0.0	0	0.00	0	0.00	0	0.00	38
4.	Purba Bardhaman	10	215.9	50,20,868	40,24,000	0.0	1	28.32	21	116.11	0	0.00	522
5.	Paschim Medinipur	17	92.6	61,64,477	0	0.0	4	300.20	84	185.56	1	14.16	1053
6.	Purba Medinipur	17	152.2	49,29,500	0	0.0	0	0.00	136	254.21	0	0.00	931
7.	Hooghly	6	76.1	11,90,730	0	0.0	0	0.00	3	14.16	0	0.00	149
8.	Howrah	14	86.5	2,30,800	4,49,700	0.0	0	0.00	0	0.00	0	0.00	53
9.	North 24-Parganas	19	57.5	0	17,42,293	6.0	2	111.87	5	53.20	1	84.96	715
10.	South 24-Parganas	31	114.8	12,26,000	28,44,860	16.8	0	0.00	197	104.65	1	18.41	1362
Total for 10 Districts		126	841.8	2,05,06,375	90,60,853	22.8	15	1526.17	448	750.54	3	117.53	5160

Table – 21.0 (Contd.)

Sl. No.	District	Estimated Cost for						Total estimated cost (₹ Crore)
		Dry excavation (₹ Crore)	Wet excavation (₹ Crore)	Lining & channels (₹ Crore)	Major Sluices / Regulators including outfall sluices (₹ Crore)	Field Inlets (₹ Crore)	Pump Houses (₹ Crore)	
3.	Paschim Bardhaman	5.20	0.00	0.00	0.00	0.00	0.00	5.20
4.	Purba Bardhaman	50.21	93.36	0.00	8.50	8.71	0.00	160.78
5.	Paschim Medinipur	61.64	0.00	0.00	90.06	13.92	33.98	199.60
6.	Purba Medinipur	49.30	0.00	0.00	0.00	19.07	0.00	68.37
7.	Hooghly	11.91	0.00	0.00	0.00	1.06	0.00	12.97
8.	Howrah	2.31	10.43	0.00	0.00	0.00	0.00	12.74
9.	North 24-Parganas	0.00	40.42	25.00	80.00	3.99	203.90	353.31
10.	South 24-Parganas	12.26	66.00	38.84	0.00	7.85	44.18	169.13
Total		205.07	210.21	63.84	504.29	56.30	282.06	1321.77

Considering the limited working time available for drainage improvement works due to monsoon and other factors, the project implementation period is considered as 5 years. Total requirement of fund during this period would be ₹ 1652.21 crore (₹ 1321.77 crore x 1.25). As against this, likely availability of normal budgetary funds, considering the 100% of total BE for drainage improvement works in 2017-18, i.e. ₹ 140 crore and expecting the same to increase annually @ 15%, becomes ₹ 945 crore (₹ 140 crore x 3 x 1.35). Accordingly, the **funding gap would be for a sum of ₹ 707.21 crore** (₹ 1625.21 cross less ₹ 945 crore).

8.8.4 Project Benefits

Implementation of the measures considered in the project would reduce drainage congestion in around 5107 sqkm area, which includes a part of Kolkata Metropolitan Area, where it is desirable to have zero tolerance to prolonged inundation. Direct benefits quantifiable in monetary terms, together with indirect social and environmental benefits would be immense and the ever increasing pressure of executing cost intensive maintenance, works at close intervals would also be relieved considerably.

9.0 Rural Connectivity Sector

9.1 Replacement of wooden or old and dilapidated RCC bridges over irrigation canals and drainage channels, by new RCC bridges, in 10 South Bengal Districts, i.e. Birbhum, Bankura, Paschim & Purba Bardhaman, Paschim & Purba Medinipur, Hooghly, Kolkata and North & South 24-Parganas (Project ID: IW/BR/1)

9.1.1 Rationale & Objectives

As explained in Paragraph 4.0 (d), old wooden or other types of narrow and worn out bridges constructed by the I&W Department decades ago, have been identified for replacement by new bridges having carriageway width generally varying from 3.0 m to 7.5 m, depending on the traffic volume and commensurate with the existing width as well as prospective width of connecting roads in future. Bridges constructed by the I&W Department on National Highway / State Highway / Major District Roads are being handed over to the PW & PW (Roads) Department and accordingly those have been excluded from such identification. Also, the demands for construction of bridges at new locations have generally not been considered, due to taking up such works by various other Government Departments / Organizations. Benefits of taking up project of such planned replacement of bridges in a phased manner have also been highlighted in the Paragraph 4.0 (d). Districtwise list of the bridges identified for replacement is shown below in Table – 22.0.

Table – 22.0

Sl. No.	District	No. of bridges to be replaced	Total length of replacement (m)
1.	Birbhum	63	848.3
2.	Bankura	69	1732.0
3.	Paschim Bardhaman	6	260.0
4.	Purba Bardhaman	52	1536.0
5.	Paschim Medinipur	355	7140.0
6.	Purba Medinipur	187	6500.8
7.	Hooghly	44	815.0
8.	Howrah	50	1921.5
9.	North 24-Parganas	178	3793.5
10.	South 24-Parganas	10	236.5
Total		1014	24783.6

9.1.2 Construction Methodology & Project Items

Substructure of the bridges, i.e. mostly piers and abutments would rest on either open foundation or there would be cast-in-situ bored piles which would further be extended to function as piers. Superstructure would generally be slab and beam type or only slab type where span length is less than 6m. Individual span lengths would generally vary from 6m to 15m and total length of the bridges would seldom exceed 60m. Considering the difficulties of maintaining the quality of cast-in-situ construction works in remote areas and also time taken for such construction, feasibility is being explored for construction of standardized prefabricated and segmented RCC beams of fixed length in centralized casting yards, for a cluster of 15 to 20 bridges of similar type, either at Block level or at G.P. level. Such precast beams upto 10 m length may be transported to the sites by trailers, subject to proper access and scope of maneuverability in the connecting roads, and lifted in position of top of piers using cranes. Deck slabs would be cast finally on top of the beams and the entire section would be post-tensioned to have the required monolithic effect and strength. This process would ensure quality and would reduce the construction time to a great extent as casting of beams will be carried out throughout the year in the yards with much higher production rate. The I&W Department officials have examined a similar project of large scale replacement of old bridges by prefabricated and segmental bridges recently executed in Assam. A pilot project of this type for 30 odd bridges is being taken up by the I&W Department and the experience from this would be replicated on a large scale. It has been assessed that construction cost of such precast segmented bridges would be more or less same with that of conventional bridges.

9.1.3 Estimated Cost and Assessment of Funding Gap

The project cost has been assessed districtwise on the basis of following considerations:

- a) Ratio of number of bridges having carriageway width of 4.25 m or less and those bridges having higher carriageway width would be 2:1.
- b) 30% of the total bridges would rest on open foundation, while 70% bridges would have deep foundation, in the form of cast-in-situ bored piles cum piers.
- c) Average cost of bridges, having carriageway width upto 4.25 m and considering the apportionment of foundation criteria, stated in (b) above, would be ₹ 6.67 lakh/metre length, based on experience of similar bridges constructed recently.
- d) Such average cost of bridges having carriageway width exceeding 4.25 m would be ₹ 8.96 lakh/metre length on similar considerations.
- e) Accordingly, average cost of construction becomes ₹ 7.43 lakh/metre $[(2 \times ₹ 6.67 \text{ lakh/metre} + 1 \times ₹ 8.96 \text{ lakh/metre}) \div 3]$.

Total estimated cost of bridges calculated based on the above considerations is shown below districtwise in Table – 23.0.

Table – 23.0

Sl. No.	District	No. of bridges to be replaced	Estimated Cost (Crore of ₹)
1.	Birbhum	63	63.03
2.	Bankura	69	128.69
3.	Paschim Bardhaman	6	19.32
4.	Purba Bardhaman	52	114.12
5.	Paschim Medinipur	355	530.50
6.	Purba Medinipur	187	483.01
7.	Hooghly	44	60.55
8.	Howrah	50	142.76
9.	North 24-Parganas	178	281.86
10.	South 24-Parganas	10	17.58
Total		1019	1841.42

Considering a 5 year implementation period, on consideration of scattered worksites in remote rural areas, total requirement of fund during the project period would be ₹ 2301.77 crore (₹ 1841.42 crore x 1.25). As against this, likely availability of normal budgetary funds, considering 5% of total BE for irrigation and flood management works in 2017-18, i.e. ₹ 49.70 crore [0.05 x (₹ 734 crore + ₹ 260 crore)] and expecting the same to increase annually @ 15% per year, becomes ₹ 402.57 crore (₹ 49.70 crore x 6 x 1.35). Accordingly, the **funding gap would be of ₹ 1966.29 crore** (₹ 2301.77 cross less ₹ 335.48 crore).

9.1.4 Project Benefits

Implementation of the project will improve rural connectivity to a great extent by reducing the travel time and consequent savings in fuel expenses. Now transport routes would be opened taking the advantage of better connectivity. Farmers would be able to transport the agricultural produces to nearby markets or warehouses at cheaper costs.

ANNEX

SUMMARY TABLE SHOWING PROJECTWISE ASSESSMENT OF INFRASTRUCTURE GAP FUNDING IN RESPECT OF THE IRRIGATION & WATERWAYS DEPARTMENT

SUMMARY ANALYSIS FOR IDENTIFICATION OF CRITICAL INFRASTRUCTURE GAP

1. Irrigation Sector

Name of the Project : **1.1 Rejuvenation and improvement of 5 Major Irrigation Projects.**

Project ID : **IW/I/1**

(Figures in ₹ Crore)

Project rationale and likely benefits in brief	Physical targets / expected outcomes	Total fund required during the project period	Proposed period of implementation	Normal budgetary support expected during the implementation period	Quantum of gap funding	Remarks																										
(1)	(2)	(3)	(4)	(5)	(6 = 3 – 5)	(7)																										
<ul style="list-style-type: none"> ● Restoration of irrigation potential and stabilizing distribution network throughout the command area. ● Increasing irrigation efficiency and establishing last mile connectivity by providing water to the plots located in the last end of the command. ● Additional yield of crops, leading to boosting up of agronomy. ● Lesser dependability on ground water extraction, by the tail end farmers. 	<p>Restoration of lost potential to the tune of 96,000 ha, as shown below:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;">Mayurakshi R P</td> <td style="width: 20%; text-align: right;">= 15,300 ha</td> </tr> <tr> <td>Hinglow I P</td> <td style="text-align: right;">= 2,914 ha</td> </tr> <tr> <td>Kangsabati R P</td> <td style="text-align: right;">= 50,053 ha</td> </tr> <tr> <td>Midnapore C P</td> <td style="text-align: right;">= 8,433 ha</td> </tr> <tr> <td>Teesta B P</td> <td style="text-align: right;">= 19,300 ha</td> </tr> <tr> <td style="text-align: right;">Total</td> <td style="text-align: right; border-top: 1px solid black;">= 96,000 ha</td> </tr> </table>	Mayurakshi R P	= 15,300 ha	Hinglow I P	= 2,914 ha	Kangsabati R P	= 50,053 ha	Midnapore C P	= 8,433 ha	Teesta B P	= 19,300 ha	Total	= 96,000 ha	2160.55	5 years	1035.05	1107.55	<p>Major irrigation Projectwise requirement of fund shown below:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>Sub-Project</u></th> <th style="text-align: right;"><u>Cost</u></th> </tr> </thead> <tbody> <tr> <td>Mayurakshi R P</td> <td style="text-align: right;">= 365.29</td> </tr> <tr> <td>Hinglow I P</td> <td style="text-align: right;">= 69.57</td> </tr> <tr> <td>Kangsabati R P</td> <td style="text-align: right;">= 1063.56</td> </tr> <tr> <td>Midnapore C P</td> <td style="text-align: right;">= 201.34</td> </tr> <tr> <td>Teesta B P</td> <td style="text-align: right;">= 460.79</td> </tr> <tr> <td style="text-align: right;">Total</td> <td style="text-align: right; border-top: 1px solid black;">= 2160.55</td> </tr> </tbody> </table> <p>B & I system of Damodar Valley Project already considered under external funding has been excluded.</p>	<u>Sub-Project</u>	<u>Cost</u>	Mayurakshi R P	= 365.29	Hinglow I P	= 69.57	Kangsabati R P	= 1063.56	Midnapore C P	= 201.34	Teesta B P	= 460.79	Total	= 2160.55
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Total	= 2160.55																															

Legend: R P : Reservoir Project
C P : Canals Project

I P : Irrigation Project
BP : Barrage Project

1. Irrigation Sector

Name of the Project : **1.2 Rejuvenation and improvement of 57 Medium & Minor Surface Irrigation Schemes in Purulia, Jhargram, Bankura & Jalpaiguri Districts.**

Project ID : **IW/I/2**

(Figures in ₹ Crore)

Project rationale and likely benefits in brief	Physical targets / expected outcomes	Total fund required during the project period	Proposed period of implementation	Normal budgetary support expected during the implementation period	Quantum of gap funding	Remarks												
(1)	(2)	(3)	(4)	(5)	(6 = 3 – 5)	(7)												
<ul style="list-style-type: none"> Restoration of irrigation potential and providing quicker and tangible benefits to the farmers. 	Restoration of lost potential to the tune of 10,000 ha.	300.00	3 years	135.72	164.28	Districtwise break up of schemes and cost: <table style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="2" style="text-align: right;"><u>Cost</u></td> </tr> <tr> <td>Purulia (32 Nos.)</td> <td style="text-align: right;">= 180.00</td> </tr> <tr> <td>Bankura (11 Nos.)</td> <td style="text-align: right;">= 70.53</td> </tr> <tr> <td>Jhargram (13 Nos.)</td> <td style="text-align: right;">= 30.33</td> </tr> <tr> <td>Jalpaiguri</td> <td style="text-align: right;">= 19.14</td> </tr> <tr> <td style="text-align: right;">Total</td> <td style="text-align: right;">= 300.00</td> </tr> </table>	<u>Cost</u>		Purulia (32 Nos.)	= 180.00	Bankura (11 Nos.)	= 70.53	Jhargram (13 Nos.)	= 30.33	Jalpaiguri	= 19.14	Total	= 300.00
<u>Cost</u>																		
Purulia (32 Nos.)	= 180.00																	
Bankura (11 Nos.)	= 70.53																	
Jhargram (13 Nos.)	= 30.33																	
Jalpaiguri	= 19.14																	
Total	= 300.00																	

1. Irrigation Sector

Name of the Project : **1.3 Construction of 11 nos. rubber dams across drainage channels & rivers in the districts of Purba Bardhaman, Hooghly & North 24-Parganas.**

Project ID : **IW/I/3**

(Figures in ₹ Crore)

Project rationale and likely benefits in brief	Physical targets / expected outcomes	Total fund required during the project period	Proposed period of implementation	Normal budgetary support expected during the implementation period	Quantum of gap funding	Remarks
(1)	(2)	(3)	(4)	(5)	(6 = 3 – 5)	(7)
<ul style="list-style-type: none"> ● Storing of last monsoon flow and post monsoon base flow for irrigation & other purposes during dry season. ● Harnessing tidal flow of river Hooghly and tributaries from end of monsoon till the first quarter of the next calendar year, for winter and early summer irrigation. ● Arresting siltation in identified stretches of tidal rivers like Ichhamati in North 24-Parganas and storing rainwater in the upstream for irrigation and other purposes. ● Groundwater recharging. ● It is expected to create an one time storage of 1165 ha-m and total storage of 2165 ha-m considering replenishment of one time storage. Likely creation of additional potential would be to the tune of 4800 ha. 	<p>Construction of interventions across rivers / channels / canals for a total length of 600m, at 11 locations with average depth of storage of 0.75m for small 9 dams and 2.25m for 2 large dams.</p>	133.48	3 years	0.00	133.48	This will be a pilot project, never attempted before and there would be immense potential of taking up such projects in other areas, after observing the performance of this pilot project.

2. Flood Management Sector

Name of the Project : **2.1 Reconstruction, improvement and extension of flood management infrastructure in the districts of Darjeeling (SMP Area), Jalpaiguri, Alipurduar and Coochbehar.**

Project ID : **IW/FM/1**

(Figures in ₹ Crore)

Project rationale and likely benefits in brief	Physical targets / expected outcomes	Total fund required during the project period	Proposed period of implementation	Normal budgetary support expected during the implementation period	Quantum of gap funding	Remarks
(1)	(2)	(3)	(4)	(5)	(6 = 3 – 5)	(7)
<ul style="list-style-type: none"> ● Rehabilitation of the existing infrastructure damaged due to severe floods in August 2017, including raising and strengthening of existing town protective and other embankments in the erstwhile protected areas to avoid spilling / overtopping. ● Rehabilitation of damaged bank protection works and undertaking new bank protection works and river training works to minimise loss of land due to erosion and avulsion of rivers, during high floods. ● Construction of new embankment lines in unprotected areas to prevent ingress of flood water, leading to damage of crops, public utilities and private and public properties. ● Likely total benefitted area after implementation of all sorts of flood management works would be to the tune of 848 sqkm in the 4 districts. 	<ul style="list-style-type: none"> ● Improvement of = 213.5 km existing embankment ● Construction of = 53.0 km new embankment ● Bank protection = 478.5 km works <li style="text-align: right;">Total = 745.0 km ● River training = 314 Nos. works, e.g. spurs, deflectors 	1589.00	5 years	990.90	598.10	<p>Districtwise breakdown of total length of work including improvement of existing embankments, construction of new embankments and bank protective works is shown below:</p> <ul style="list-style-type: none"> ■ Darjeeling = 125 km (SMP) ■ Jalpaiguri = 210 km ■ Alipurduar = 61 km ■ Coochbehar = 349 km <li style="text-align: right;">Total = 745 km

2. Flood Management Sector

Name of the Project : **2.2 Reconstruction & improvement of flood management infrastructure in the districts of Uttar Dinajpur, Dakshin Dinajpur & Malda.**

Project ID : **IW/FM/2**

(Figures in ₹ Crore)

Project rationale and likely benefits in brief	Physical targets / expected outcomes	Total fund required during the project period	Proposed period of implementation	Normal budgetary support expected during the implementation period	Quantum of gap funding	Remarks
(1)	(2)	(3)	(4)	(5)	(6 = 3 – 5)	(7)
<ul style="list-style-type: none"> ● Rehabilitation of the existing infrastructure damaged due to severe floods in August 2017, including raising and strengthening of existing town protective and other embankments in the erstwhile protected areas to avoid spilling / overtopping. ● Rehabilitation of existing bank protective works and construction of new anti-erosion and river training works to minimise damage due to erosion. ● Implementing new drainage schemes to benefit rural and municipal areas. ● Constructing new sluice structures for easement of drainage congestion. ● Likely total benefitted area after implementation of all sorts of flood management works would be to the tune of 1952 sqkm. 	<ul style="list-style-type: none"> ● Improvement of existing embankment = 300.0 km ● Bank protection works = 104.6 km ● River training works, e.g. deflectors/spurs = 6 Nos. ● Open drainage Channel improvement = 28.0 km ● Underground conduit construction = 1.75 km ● New Pump House = 1 No. ● New Culverts / Bridges = 7 Nos. ● New Sluice Structures = 28 Nos. 	771.22	3 years	255.43	515.79	<p>Districtwise break down of total length of embankment and bank protection is shown below:</p> <p>U Dinajpur = 95.0 km D Dinajpur = 70.0 km Malda = 239.6 km Total = 404.6 km</p> <p>All drainage improvement works are in Malda, comprising re-excavation of offtake of river Kalindri, improvement of river Pagla with construction of a regulator at Pagla river closure and Laximipur Drainage Scheme for Englishbazar Municipality.</p>

2. Flood Management Sector

Name of the Project : **2.3 Anti-erosion and river training works of critical stretches on rivers Ganga-Padma and Bhagirathi in the districts of Malda, Murshidabad and Nadia.**

Project ID : **IW/FM/3**

(Figures in ₹ Crore)

Project rationale and likely benefits in brief	Physical targets / expected outcomes	Total fund required during the project period	Proposed period of implementation	Normal budgetary support expected during the implementation period	Quantum of gap funding	Remarks
(1)	(2)	(3)	(4)	(5)	(6 = 3 – 5)	(7)
<ul style="list-style-type: none"> ● Severe erosion on Ganga-Padma river system has already affected 2800 ha of land in last 12 years. Taking into consideration Bhagirathi erosion, total damage due to loss of land, public & private properties and utilities is colossal. ● Farakka Barrage Project (FBP) Authority under MoWR, RD & GR has recently withdrawn from taking up of anti-erosion works in their extended jurisdiction on Ganga-Padma. Now, the State Government has to shoulder the entire responsibility for protect-ting thousands of affected people ● Implementation of the project would protect 961 ha of area from further erosion and would consequently save private and public assets, worth ₹ 1725.00 crore (approx.). 	<ul style="list-style-type: none"> ● Bank protection on = 32.45 km Ganga-Padma (both banks) ● Bank protection on = 42.60 km Bhagirathi (both banks) ● Number of spurs / = 3 Nos. river training works on Ganga-Padma 	895.63	5 years	0.00	895.63	Districtwise affected length on Ganga-Padma considering both banks is shown below: <u>Ganga-Padma</u> Malda = 15.10 km Murshidabad = 16.85 km Nadia = 0.50 km <u>Bhagirathi</u> Murshidabad = 27.15 km Nadia = 15.45 km

2. Flood Management Sector

Name of the Project : **2.4 Ghatal Master Plan (Phase-I Works) in Paschim & Purba Medinipur Districts.**

Project ID : **IW/FM/4**

(Figures in ₹ Crore)

Project rationale and likely benefits in brief	Physical targets / expected outcomes	Total fund required during the project period	Proposed period of implementation	Normal budgetary support expected during the implementation period	Quantum of gap funding	Remarks
(1)	(2)	(3)	(4)	(5)	(6 = 3 – 5)	(7)
<ul style="list-style-type: none"> ● Ghatal subdivision and adjoining areas in Purba & Paschim Medinipur is historically flood prone. ● Measures taken to mitigate floods during last couple of decades were sporadic and scattered, failing to provide long term benefit in the entire area. ● I&WD for the first time, has prepared a Master Plan for drainage improvement and flood management in the entire project area, after detailed field survey and mathematical medelling. ● The Master Plan is proposed to be implemented in phases and DPR is ready for implementation of Phase-I works for providing sustainable benefit in around 657 sqkm area, by minimising flood losses in 9 Blocks in Paschim & Purba Medinipur, including 2 Municipalities. 	<ul style="list-style-type: none"> ● River / channel re-excavation & improvement of appurtenant embankments = 147 km ● Pump Houses = 2 Nos. ● Regulator = 2 Nos. ● Retaining Wall = 2 km ● Bridges = 2 Nos. ● Khirai Buxi Drainage Scheme = 1 No. ● Ghatal Circuit Embankment = 16 km ● Kangsabati right embankment improvement = 6 km ● Dwarf Wall on embankment top = 148 km ● Land procurement = 20 ha 	1238.95	4 years	0.00	1238.95	This is one of the top priority projects of the I&WD, awaiting implementation for a long time. The DPR has techno-economically been cleared by the Advisory Committee of MoWR, RD & JR, Gol. Investment clearance for inclusion under centrally assisted Flood Management Project with sharing pattern of 50 (GoI) : 50 (GoWB) has been withheld for more than two years, inspite of compliance of all observations given by the Gol from time to time till September 2017 and communicating request by Hon'ble Chief Minister to Hon'ble Prime Minister on two occasion, i.e. on June 2015 & September 2017.

2. Flood Management Sector

Name of the Project : **2.5 Raising, strengthening and improvement of flood embankments owned and maintained by the I&W Department in 12 South Bengal Districts, i.e. Murshidabad, Birbhum, Nadia, Paschim & Purba Bardhaman, Paschim & Purba Medinipur, Jhargram, Hooghly, Howrah, North & South 24-Parganas.**

Project ID : **IW/FM/5**

(Figures in ₹ Crore)

Project rationale and likely benefits in brief	Physical targets / expected outcomes	Total fund required during the project period	Proposed period of implementation	Normal budgetary support expected during the implementation period	Quantum of gap funding	Remarks																																										
(1)	(2)	(3)	(4)	(5)	(6 = 3 – 5)	(7)																																										
<ul style="list-style-type: none"> I&W Department at present maintain 9131 km length of embankment in the said 12 South Bengal districts, many of which were built decades back. Embankments, mostly earthen, have become weak and fragile at many places due to damages inflicted by high water level and wave dash, during recurring floods, leading to collapse Raising / strengthening and improvement of these embankments are essentially required to minimise the damages to agricultural crops, public utilities and private assets, caused due to flood water ingressing countryside by overtopping, breaching of embankments Implementation of the project would provide benefit to 2596 sqkm of area in these districts 	Districtwise length (km) of embankment to be improved: <table style="margin-left: 20px;"> <tr><td>Murshidabad</td><td>=</td><td>69.0</td></tr> <tr><td>Birbhum</td><td>=</td><td>35.0</td></tr> <tr><td>Nadia</td><td>=</td><td>18.5</td></tr> <tr><td>Paschim Bardhaman</td><td>=</td><td>3.5</td></tr> <tr><td>Purba Bardhaman</td><td>=</td><td>69.5</td></tr> <tr><td>Paschim Medinipur</td><td>=</td><td>37.0</td></tr> <tr><td>Purba Medinipur</td><td>=</td><td>180.0</td></tr> <tr><td>Jhargram</td><td>=</td><td>6.0</td></tr> <tr><td>Hooghly</td><td>=</td><td>30.7</td></tr> <tr><td>Howrah</td><td>=</td><td>11.0</td></tr> <tr><td>North 24-Parganas</td><td>=</td><td>19.6</td></tr> <tr><td>South 24-Parganas</td><td>=</td><td>38.0</td></tr> <tr><td>Total</td><td>=</td><td>517.8</td></tr> <tr><td>Say</td><td>=</td><td>518 km</td></tr> </table>	Murshidabad	=	69.0	Birbhum	=	35.0	Nadia	=	18.5	Paschim Bardhaman	=	3.5	Purba Bardhaman	=	69.5	Paschim Medinipur	=	37.0	Purba Medinipur	=	180.0	Jhargram	=	6.0	Hooghly	=	30.7	Howrah	=	11.0	North 24-Parganas	=	19.6	South 24-Parganas	=	38.0	Total	=	517.8	Say	=	518 km	670.10	3 years	383.15	286.95	Stretches of embankments already included under (a) ongoing “Kandi Master Plan” in Murshidabad and Birbhum Districts, (b) approved externally funded “West Bengal Major Irrigation & Flood Management Project” in Purba Bardhaman, Bankura, Hooghly & Howrah Districts, and (c) upcoming “Ghatal Master Plan” in Paschim & Purba Medinipur have been excluded from the scope of this project.
Murshidabad	=	69.0																																														
Birbhum	=	35.0																																														
Nadia	=	18.5																																														
Paschim Bardhaman	=	3.5																																														
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South 24-Parganas	=	38.0																																														
Total	=	517.8																																														
Say	=	518 km																																														

2. Flood Management Sector

Name of the Project : **2.6 Improvement of Ex-zamindary embankments in 11 Districts, i.e. Uttar & Dakshin Dinajpur, Murshidabad, Birbhum, Purba & Paschim Bardhaman, Purba & Paschim Medinipur, Hooghly & Howrah.**

Project ID : **IW/FM/6**

(Figures in ₹ Crore)

Project rationale and likely benefits in brief	Physical targets / expected outcomes	Total fund required during the project period	Proposed period of implementation	Normal budgetary support expected during the implementation period	Quantum of gap funding	Remarks
(1)	(2)	(3)	(4)	(5)	(6 = 3 – 5)	(7)
<ul style="list-style-type: none"> It has been decided by the State Government that I&W Department will take over maintenance of Ex-zamindary embankments from the local Panchayat Authorities, for planned improvement in consideration of various technical aspects including impacts of strengthening these embankments on the adjoining I&WD flood embankments. Raising and strengthening of these embankments, to the extent feasible and keeping in view the prevailing site conditions are necessary to minimise flood damage losses in areas protected by these embankments. As there would be considerable addition over existing I&WD assets, it may be difficult to arrange funds out of normal budgetary provision, due to pressing requirements and their commitments. Benefitted area in terms of minimisation of flood losses would be to the tune of 813 sqkm. 	Districtwise length (km) of embankment to be improved: Uttar Dinajpur = 8.1 Dakshin Dinajpur = 42.0 Malda = 6.0 Murshidabad = 9.9 Birbhum = 24.1 Purba & Paschim = 130.0 Bardhaman Purba Medinipur = 57.0 Paschim Medinipur = 63.0 Hooghly = 95.0 Howrah = 81.0 Total = 516.1 Say = 516 km	732.30	3 years	0.00	732.30	Detailed inventory of the Ex-zamindary embankments is yet to be received from the Panchayat & Rural Development Department. Accordingly, the project proposal has been framed on the basis of primary rough assessment.

2. Flood Management Sector

Name of the Project : **2.7 River bank protection works in 10 South Bengal Districts, i.e. Bankura, Birbhum, Paschim & Purba Medinipur, Jhargram, Paschim & Purba Bardhaman, Hooghly, Howrah & South 24-Parganas and Coastal protection and beautification works in Purba Medinipur District.**

Project ID : **IW/FM/7**

(Figures in ₹ Crore)

Project rationale and likely benefits in brief	Physical targets / expected outcomes	Total fund required during the project period	Proposed period of implementation	Normal budgetary support expected during the implementation period	Quantum of gap funding	Remarks
(1)	(2)	(3)	(4)	(5)	(6 = 3 – 5)	(7)
<ul style="list-style-type: none"> ● River bank erosion in the South Bengal districts, attributable to meandering of rivers, fluctuation of flow, and cohesion less bank and bed materials continues to be a major challenge to face. Coastal erosion in Digha-Shankarpur area is also another major cause of concern. ● Such erosion is engulfing land, and other public utilities and properties and also private properties worth thousands of crore. ● Erosion is not a listed calamity as per Gol norms of disaster management, hence affected persons seldom get compensation or relief. ● Accordingly, it has become necessary to formulate the proposal to protect 81,800 ha of land in the 9 districts of South Bengal. 	Districtwise length (km) of work in different districts: Bankura = 45.9 Birbhum = 5.4 Paschim Medinipur = 17.8 Purba Medinipur = 42.8 Jhargram = 19.8 Paschim Bardhaman = 2.1 Purba Bardhaman = 99.2 Hooghly = 3.7 Howrah = 2.3 South 24-Parganas = 37.0 Total = 276.0 This includes 7 coastal protection and beautification work for a length of 2.8 km at Shankarpur area, in Purba Medinipur.	1178.00	3 years	510.86	667.14	Main rivers causing erosion in the 10 districts are: <ul style="list-style-type: none"> ■ Bhagirathi - Hooghly ■ Dwarakeswar ■ Gandheswari ■ Kangsabati ■ Silabati ■ Rupnarayan ■ Damodar and numerous creeks in Sundarban areas.

2. Flood Management Sector

Name of the Project : **2.8 Rejuvenation and improvement of the drainage infrastructure in 10 South Bengal Districts, i.e. Nadia, Bankura, Paschim & Purba Bardhaman, Paschim & Purba Medinipur, Hooghly, Howrah and North & South 24-Parganas.**

Project ID : **IW/FM/8**

(Figures in ₹ Crore)

Project rationale and likely benefits in brief	Physical targets / expected outcomes	Total fund required during the project period	Proposed period of implementation	Normal budgetary support expected during the implementation period	Quantum of gap funding	Remarks
(1)	(2)	(3)	(4)	(5)	(6 = 3 – 5)	(7)
<ul style="list-style-type: none"> ● Around 36% of the total geographical area of these 10 districts is flood prone. ● Siltation in the drainage channels and rivers criss-crossing the area causing reduction of carrying capacities and increased discharge in semi urban and urban areas, in and around Kolkata Metropolitan area due to change in land use pattern, coupled with adverse outfall conditions, are the major challenges. ● Accordingly, with a view to supplement the comprehensive action plan and in continuation of the series of ongoing activities further measures including re-excavation of channels and rivers, construction of regulating structures at critical points and addition of capacities of existing pump houses along with construction of new pump houses, are essentially required to revitalise the overstressed drainage infrastructure. ● The project aims at easing drainage congestion in around 5107 sqkm of area, which includes Kolkata Metropolitan and adjoining areas. 	<p>Summary of the project components proposed for implementation in the said 10 districts are:</p> <ul style="list-style-type: none"> ● Improvement of drainage channel = 841.7 km ● Length of channel lining = 22.8 km ● Major Sluices = 15 Nos. ● Addition of capacities = 1526 cumec ● Field Inlets = 448 Nos. ● Addition of capacities = 750 cumec ● Pump Houses (new + augmentation) = 3 Nos. ● Capacity to be installed (for districtwise details, refer to Table-20 under Para 8.9.2) = 118 cumec 	1652.21	5 years	945.00	707.21	Major projects already ongoing or considered under external funding (i.e. West Bengal Major Irrigation and Flood Management Project for Lower Damodar areas) and also components considered under Ghatal Master Plan (vide SI.7) have been excluded from the scope of this project.

3. Rural Connectivity Sector

Name of the Project : **3.1 Replacement of wooden or old and dilapidated other types of bridges over irrigation canals and drainage channels, by new RCC bridges, in 10 South Bengal Districts, i.e. Birbhum, Bankura, Paschim & Purba Bardhaman, Paschim & Purba Medinipur, Hooghly, Kolkata and North & South 24-Parganas.**

Project ID : **IW/BR/1**

(Figures in ₹ Crore)

Project rationale and likely benefits in brief	Physical targets / expected outcomes	Total fund required during the project period	Proposed period of implementation	Normal budgetary support expected during the implementation period	Quantum of gap funding	Remarks																																	
(1)	(2)	(3)	(4)	(5)	(6 = 3 – 5)	(7)																																	
<ul style="list-style-type: none"> ● Wooden bridges have become obsolete with the change of nature and intensity of traffic, even in remote rural areas. ● Similarly, narrow or lighter bridges built by the I&W Department over irrigation canals and channels decades back, cannot simply cope up with the increased traffic load. ● Replacement of these bridges, if made in sync with the ongoing project of improving rural road network under PMGSY and other programmes, would provide very effective rural connectivity and quicker access to District / Subdivision / Block Headquarters, Schools, Colleges, Markets, etc.. 	<p>1014 nos. of RCC bridges with carriageway width varying from 3.0m to 7.5m maximum and length upto 60m. Districtwise number of bridges shown below:</p> <table> <tr> <td>Birbhum</td> <td>=</td> <td>63</td> </tr> <tr> <td>Bankura</td> <td>=</td> <td>69</td> </tr> <tr> <td>Paschim Bardhaman</td> <td>=</td> <td>6</td> </tr> <tr> <td>Purba Bardhaman</td> <td>=</td> <td>52</td> </tr> <tr> <td>Paschim Medinipur</td> <td>=</td> <td>355</td> </tr> <tr> <td>Purba Medinipur</td> <td>=</td> <td>187</td> </tr> <tr> <td>Hooghly</td> <td>=</td> <td>44</td> </tr> <tr> <td>North 24-Parganas</td> <td>=</td> <td>50</td> </tr> <tr> <td>South 24-Parganas</td> <td>=</td> <td>178</td> </tr> <tr> <td>Kolkata</td> <td>=</td> <td>10</td> </tr> <tr> <td>Total</td> <td>=</td> <td>1014</td> </tr> </table>	Birbhum	=	63	Bankura	=	69	Paschim Bardhaman	=	6	Purba Bardhaman	=	52	Paschim Medinipur	=	355	Purba Medinipur	=	187	Hooghly	=	44	North 24-Parganas	=	50	South 24-Parganas	=	178	Kolkata	=	10	Total	=	1014	2301.77	5 years	335.48	1966.29	Bridges on National Highways / State Highways / Major District Roads are being handed over to PWD & PWD (Roads) Department in phases. As such, these bridges have been excluded.
Birbhum	=	63																																					
Bankura	=	69																																					
Paschim Bardhaman	=	6																																					
Purba Bardhaman	=	52																																					
Paschim Medinipur	=	355																																					
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